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ABSTRACT

This report is concerned with the formulation of a sequence for the spelling-to-sound correspondence rules that cover the 1- and 2-syllable words in the speech comprehension vocabularies of 6- and 9-year-olds. One major function of the rule sequence is to serve as a basis for developing reading instruction materials for the sequence and content of phonics instruction, the selection of vocabulary consonant with the rule sequence, and the designation of a sight-word vocabulary. A second broad function is to generate materials for empirical studies on the acquisition of word attack skills. The sequence, including organizational guidelines and rationale for sequencing decisions, and the background and supporting data used to construct the sequence are presented in the report. A bibliography is included. (WB)

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An Instructional Sequence for Spelling-to-Sound Correspondences for the One-and Two-Syllable Words in Vocabularies of 6-9 Year-Olds

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AN INSTRUCTIONAL SEQUENCE FOR SPELLING-TO-SOUND CORRESPONDENCES FOR THE ONE- AND TWO-SYLLABLE WORDS IN VOCABULARIES OF 6-9 YEAR-OLDS

Peter Desberg and Bruce Cronnell

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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PREFACE

This paper represents an initial attempt at sequencing the rules of correspondence developed by the SWRL Word Attack Activity (Berdiansky, Cronnell, and Koehler, 1969). The rule sequence is concerned primarily with phonics instruction and consequently does not operate under the same constraints as a total reading program. A flexible format was used to make the work of greater use to the developers of the reading program; however, minor modifications of this sequence are inevitable.

Rule sequence modifications will have two sources of input:

(1) The program developers--changes will result from constraints due to specific program needs (e.g., vocabulary words for stories); and

(2) The word attack activity--sequencing problems will be empirically examined in an attempt to accelerate instruction.

The sequence, including organizational guidelines and rationale for sequencing decisions, is contained in Section IV. The remainder of the paper presents the background and supporting data used to construct the sequence.

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GLOSSARY

Environmental Complexity
: The number of environmental constraints on a given rule.

Graphemic Regularity
: The number of different pronunciations for a given grapheme unit.

Grapheme Unit Complexity
: Amount of information needed to process a rule, disregarding environment (grapheme unit complexity is related to the number of letters comprising a unit).

Productivity
: A term used interchangeably with "rule occurrence frequency."

Rule Occurrence Frequency
: The number of times a rule applies to a specified vocabulary content.

Rule Pair-Per-Word Frequency
: The number of words, in a specified vocabulary, to which a given pair of rules applies in each of the words.

Rule Regularity
: The number of different pronunciations for a given grapheme unit within a specified environment.

Rule Word Frequency
: The number of words in a specified vocabulary to which a given rule applies.

Word Usage Frequency
: The number of times a word occurs in language productions (see Page 15 for criterion of high word-usage frequency).

AN INSTRUCTIONAL SEQUENCE FOR SPELLING-TO-SOUND CORRESPONDENCES FOR THE ONE- AND TWO-SYLLABLE WORDS IN VOCABULARIES OF 6-9 YEAR-OLDS

Peter Desberg and Bruce Cronnell

SECTION I
STATEMENT OF OBJECTIVES

The objective of any phonics-based reading program is the acquisition of the alphabetic principle (as opposed to character or pictographic styles of writing), which states that textual material is composed of segmented units (consonants and vowels), representing phonemes, that may be recombined to form other units (Bloomfield & Barnhart, 1961). The instruction of the alphabetic principle presents little difficulty when the graphemic and phonemic elements demonstrate a close fit. Such, however, is not the case with English orthography. This does not mean to imply that English has an unsystematic spelling system, although some reading instruction has proceeded on that assumption (Bloomfield, 1942a, 1942b). Recently, evidence has been advanced that English orthography, and its corresponding pronunciation, is systematic when more complex relations holding between spelling and sound are specified (Venezky, 1967; Wijk, 1966; Francis, 1958).

The current Word Attack activity, taking the above into account, has three overall objectives:

(1) The determination of the speech-comprehension vocabularies of 6-9 year-olds;

(2) The determination of a set of spelling-to-sound correspondence rules to cover the one- and two-syllable words in (1);

(3) The formulation of a sequence for the rules in (2).

Objectives (1) and (2) are reported in Berdiansky, Cronnell, and Koehler (1969). This report concerns the third objective.

The rule sequence reported in this paper has two broad functions:

(1) To serve as a basis for developing reading instruction material as follows:

  (a) the sequence and content of phonics instruction,

  (b) the selection of vocabulary consonant with the rule sequence,

  (c) the designation of sight-word vocabulary;

(2) To generate materials for empirical studies on the acquisition of word attack skills. Here the intention is to exploit the systematic nature of the orthographic system while minimizing sources of inter-rule interference.

At the present time there is little empirical information available to guide in the formulation of a rule sequence. In consequence, the proposed sequence was developed largely on the basis of rule frequency data and assumptions concerning learning in children. More specific sources referred to for developing the rule sequence were:

(1) a review of alternative sequences from the reading literature and the SWRL Communication Skills program;

(2) a set of sequencing guidelines;

(3) data on frequency of occurrence (see Appendix III)

  (a) rule word and occurrence frequencies,

  (b) rule frequencies broken down by age and syllabification,

  (c) frequency measures on rule-pair occurrences in words.

The next two sections describe more completely the sources used in developing the rule sequence.

SECTION II
REVIEW OF OTHER RULE SEQUENCE FORMULATIONS

A review of word attack literature (Desberg and Berdiansky, 1968) disclosed several correspondence-rule sequences. Six representative rule sequences[1] were included in this paper for comparative purposes. These represent somewhat different approaches to rule sequencing.

Two sequences, Fry (1964) and Black (1961), are based on rule occurrence frequency. Fry formulated a set of phonics rules and then ranked them according to a previous word frequency count (Moore, 1951). A suggested instructional sequence was determined from the frequency count. Black, using the phonics rules generated by Fry, checked the "phonetic elements" of 1300 words with these rules to "verify the frequency basis upon which they had been formulated" (p. 2). The words were obtained from the list of instant words (Fry, 1957) and 700 words selected from a third grade social studies book. A further comparision was made, by rule, of the frequency counts from three other sources: Moore (1951), Cordts (1963), and Kottmeyer (1954).

An intuitive approach to sequencing is exemplified by Heilman (1964), who, in a book on phonics instruction for teachers, proposes a sequence for the introduction of phonics rules. The sequence presented is "believed to be a logical sequence, but it is not implied that this is the only defensible sequence" (p. 20).

Another example of an intuitive approach to rule sequencing is Bloomfield's (1942a, 1942b; Bloomfield & Barnhart, 1961) proposal for an instructional sequence emphasizing a one-symbol, one-sound correspondence. Regularly spelled words, rather than isolated letter sounds, are sequenced in ascending order of difficulty.

The Stanford University Institute for Mathematical Studies in the Social Sciences (Hansen & Rodgers, 1965; Rodgers, 1967) uses a sequence developed, in part, on intuitive grounds and, in part, on the basis of empirical work. The Stanford project, which uses this sequence in an experimental first-year program, employs the "vocalic center group" (VCG--a close approximation to the syllable) as the nucleus of its phonics program. The rule sequence was derived using the following four principles:

(1) VCG sets containing single consonant elements are introduced before those containing consonant clusters (tap and rap before trap).

---

[1] See Appendix II for the sequences discussed in this section. All rules were transformed into SWRL Word Attack Activity notation (see Appendix I). Whenever an explanation or rationale was provided with the sequence, it was included. Comments by Desberg and Cronnell appear in brackets.

(2) VCG sets containing initial consonant clusters are introduced before those containing final consonant clusters (stop before post).

(3) VCG sets containing checked (short) vowels are introduced before those containing letter name (long) vowels (met and mat before meat or mate).

(4) Single VCG sequences are introduced before multiple VCG sequences (mat before matter, stut before stutter) (Rodgers, 1967, p. 36).

All five sequences are formed by combining rules into blocks; the blocks are then linearly ordered. In general, block sequencing tends to follow this order: Primary vowels (only one letter, i.e., a, e, i, o, u,) precede secondary vowels (two or more letters, e.g., ee, ay, oi). The "Short-vowel" rules (the 15 rules) precede all other vowel rules. In the sequencing of consonant rules, single consonants precede consonant digraphs, and consonants with invariant pronunciations precede those with variant pronunciations.

However, notable differences are found in the sequences described above. Black (1961), in sequencing vowels, introduces a block of secondary vowels immediately following the "short-vowel" rule (Rule 15). The introduction of the "vowel-r" rules is postponed until the sixth block. In sequencing the consonants, the first block, which contains 19 rules, could have been subdivided further to obtain greater homogeneity of blocks. Heilman (1964) introduces consonants before vowels (see Appendix II (3) for his rationale. In addition, consonant digraphs and consonant clusters, as well as secondary vowels, are introduced early in the consonant and vowel sequences respectively.

Bloomfield's (1942a, 1942b; Bloomfield & Barnhart, 1961) approach deserves special comment due to his very conservative approach to vowel introduction, with only 5 primary vowel rules (the 15 rules) in the first two-thirds of the program. Secondary vowels were introduced before the inclusion of the next primary vowel rules (the 11 rules). This decision to preserve regularity disregards rule frequency and the greater processing time required for secondary vowels. In addition, Bloomfield introduces a large number of minor, very unproductive rules (e.g., o → [U][2] as in woman, u →[ɛ] as in bury); words employing these rules should probably be taught as sight words.

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[2]See the Key to Pronunciation, p. 51, for pronunciation symbols used in the present report.

In the Stanford program, which covers only one year, vowel sequencing by major patterns does not appear to be fully exploited. The 11 rules are introduced before all the 15 rules are taught; the 21 rules are introduced before all the 11 and 15 rules are taught. There seem to be no orderly principles for the introduction of secondary vowels (e.g., low occurrence frequency Rules OI10 and 0012 appear before high occurrence frequency Rules EE10 and EA11).

In addition to the above programs, the contents of the SWRL First and Second Year Communication Skills Programs were analyzed to determine the extent of rule coverage and the sequence of the rules employed (see Appendix II). Excluding exceptions (40 rules), 100 rules are employed, all occurring at least once in the second-year program, and slightly more than one-fourth occurring also in the first-year program. Sixty of these rules are explicitly taught as spelling-to-sound correspondences. The others appear, primarily in sight words, without the correspondences actually being taught.

Primary vowel rules are usually grouped in terms of generalizability across letters (e.g., the 11 rule is taught for each vowel in successive weeks in the second year). Single consonants generally precede the corresponding double consonants; frequent single consonants precede consonant digraphs and less frequent single consonants.

In summation, it seems apparent that of the alternate sequences reviewed, none had a sufficiently large data base. In some cases, sequences were based on frequency counts from small lexicons (e.g., Black--1300 words; Fry--3000 words). Other sequences were based on words used in existing books (e.g., Black's use of a third-grade text; Heilman's rationale for sequencing the "short-vowel" rule first: "A majority of the words a child meets in beginning reading contain short vowel sounds..." p. 50).

Rather than working within the constraints of existing reading programs, the SWRL Word Attack Activity is developing its program on lexicon materials that sample a wider range of the beginning reader's vocabulary content (see Berdiansky, Cronnell, & Koehler, 1969, Section II). The nearly 6000 one- and two-syllable words of a 9000 word lexicon formed the data base for the rules of correspondence and their subsequent sequencing. Frequency of rule applications to the 6000-word sample was heavily relied upon in making sequencing decisions.

SECTION III
GUIDELINES FOR THE SEQUENCING OF CORRESPONDENCE RULES

This section contains the guidelines used in sequencing the correspondence rules. The first part describes rule frequency data and the second part contains additional guidelines used in the present report.

DATA ON RULE FREQUENCY

Four tables of rule frequency data were constructed to aid in the preparation of the rule sequence presented in this report. These tables, with descriptions and explanations, are found in Appendix III.

Tables 1 & 2: Rule frequencies

In sequencing the rules of correspondence, rule occurrence frequencies were weighted heavily because of their close relationship with the number of available words containing each rule, i.e., rule word frequencies. (The rank-ordered correlation between them exceeds .99.)

Tables 1 and 2 were used to derive the general pattern of the rule sequence; the following tables were used to augment it.

Table 3: Rule word frequencies: Breakdown by age and syllabification

Additional information for sequencing is provided by rule word frequencies broken down by age and syllabification. The greater use for this work should be in providing information for sequencing low-frequency rules where little relevant data is available. Also, this information will be utilized in the sequencing of rules across lists (consonants, primary vowels and secondary vowels). In addition, such a breakdown is appreciably more sensitive to sequencing problems than the list of rank-ordered rule occurrence frequencies. This information should aid in the implementation of several sequencing decisions:

(a) Rules with many one syllable exemplars will appear before those with many two-syllable exemplars;

(b) Rules with many 6-7 age level words will appear before those with many 8-9 age level words;

(c) Rules with few exceptions will appear before those with many exceptions.

Table 4: Rule pair-per-word frequencies

Rule pair-per-word frequency data was compiled to serve two major functions:

(a) To augment the information provided by rule occurrence frequencies. High percentage of co-occurrence with productive rules was a criterion for earlier rule inclusion. Rule pair-per-word frequencies had only minor effect in adjusting the rule sequence.

(b) To insure that when a rule was taught there would be co-occuring rules introduced concurrently to permit the formation of words for use in the program. This information is reflected in the Inter- and Intra-List Sequencing Contingencies found in Section IV.

ADDITIONAL SEQUENCING CONSIDERATIONS

As part of the task of determining the sequential relationships for the instruction of the rules of correspondence, a set of sequencing guidelines was formulated reflecting the systematic nature of English orthography, ignoring the surface variation from a uniform one-to-one grapheme-phoneme relationship. The complexity of English orthography is attributed, to a large extent, to the variability of the vowel system. An attempt will be made to utilize the existent systematic nature in an instructional sequence that emphasizes maximal transfer by rules across letters. Taking this into account, the following guidelines for sequencing were formulated.

I. Vowel Rules

(A) Primary vowel rules (e.g., A15, E11, I21, etc.[3]) precede secondary vowel rules (e.g., EE10, EA11, OW12, etc.). This decision is based upon three considerations, grapheme unit complexity, rule occurrence frequency, and generalizability.

(1) Grapheme unit complexity: the amount of information needed to process a rule discounting its environment. Primary vowels require less information for successful recognition or production (i.e., fewer letters must be stored in order to process a unit). The lighter storage requirements should enable the instruction to proceed at a more rapid pace.

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[3]Rule descriptions are presented in Appendix I.

(2) Rule occurrence frequency: the extent that the rule applies to a specified lexicon. There are 33[4] secondary vowel rules with a total of 1608 exemplars in the vocabulary data. There are 73 primary vowel rules with a total of 8394 exemplars in the vocabulary data.

(3) Generalizability: the common properties of two or more rules. Forty-seven of the primary vowel rules may be reduced to 10 major patterns which account for 5835 of the 8394 exemplars. They greatly enhance the opportunity for transfer across letters.

(B) Primary vowel rules 11-18 and 21 precede the remaining primary vowel rules.
The arguments favoring this decision are high rule occurrence frequencies and generalizability. The 39 rules comprising the 11-18 and 21 groups have approximately three times as many exemplars in the vocabulary data as the remaining primary vowel rules. Also the 39 rules of the 11-18 and 21 set may be reduced to 8 major rules which can be generalized across letters (see Appendix I, pp. 34-35).

(C) Primary vowels are divisible into two groups: long and short. Short vowels precede long vowels.
The criteria for this decision are rule occurrence frequency and environmental complexity.

(1) Rule occurrence frequency: Short-vowel Rules 15 and 16 (summed across letters) have 3066 exemplars. Long-vowel Rules 11-14 all involve two vowels, one functioning as a marker that conditions the preceding vowel. Rules 15 and 16 involve only one vowel per rule.

(D) Rules 15 and 11 precede 16, 12, 13, and 14.
This decision does not exploit the opportunities for rule generalization. It is made solely on the criterion of rule occurrence frequency. Rules 15 and 11 represent the two most pervasive patterns for vowel rules. Together they account for 2233 examples based upon the vocabulary data (in addition, most of the 1146 examples of E18 may be included in this total).

(E) The 11-16 series precedes the 21 rules.
Rule 21 applies when Rule 16 is not applicable. As Levin

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[4]All 40 rules (exceptions) were deleted from these tallies.

and Watson (1963) contend, children are being trained to accommodate to the variability of the English orthographic system.

> We may think of the process as one in which the child tries the first habit in a hierarchy which does not work and then tries a second habit and so on until a solution is successful. We might suppose that the closer the two habits are in the hierarchy, the more likely will a succeeding one be substituted for an unsuccessful response (p. 5).

Rule 21 has high occurrence frequency with 814 exemplars across four letters (a, e, i, o).

II. Consonant Rules

(A) Single Consonants precede digraphs and consonant clusters. Single consonants form the base for acquisition of the alphabetic principle, on both visual and auditory dimensions. Memory requirements for processing single consonants should be lower than for larger units inasmuch as fewer prerequisite skills are required in processing single consonants.

(B) Geminate consonant clusters accompany major consonant rules.
Geminate consonant clusters (e.g., Rules LL10, SS10, TT10, etc.) will be included under single consonant rules in the first revision of the rules of correspondence. For the present, they are sequenced along with, and taught as special instances of, the consonant rules.

(C) Relatively invariantly pronounced grapheme units (designated 10) precede those with two or more predominant pronunciations (designated by 11 and 12).
Storage requirements are lower for 10 rules because the pronunciations are relatively independent of environmental conditioning. This pertains not only to the various C, G, and the TH rules, but also to the S rules where the numbering is slightly altered (S10, S20, S21, and S31).

(D) Within the invariant (10) rules, continuant consonants (e.g., Rules S10, M10, V10) precede stop consonants (e.g., Rules P10, D10, K10). This sequence is proposed to enhance instruction in blending. Stop consonants cannot occur in isolation, since articulatorily, a stop is a complete closure or stoppage of air and perception of the stop is contingent upon transition to and away from the closure

or point of maximum construction (Abercrombie, 1967). Thus a stop produced in isloation will be accompanied by a vowel, which would be extraneous in the word to be pronounced. For example, the word be, normally pronounced [bi], becomes [bəi] when the letters are pronounced in isolation. Continuants, on the other hand, can be pronounced in isolation without introducing extraneous sounds.

(E) Within the continuant designation fricative consonants (e.g., Rules S10, F10) precede nasals (e.g., Rules M10, N10). At this time the following untested hypothesis is formulated to account for consonant sequencing on the dimension of blending ease: Consonant blendability is inversely related to the extent of "stopness" in the articulation of the consonant. The oral passage is open for the production of fricatives, but closed (stopped) for nasals.

(F) Sibilants (Rules S10, Z10, SH10) precede the remaining fricatives (Rules F10, V10, TH11, TH12, TH13). This decision is based upon the hypothesis stated above. It is predicted that the sibilants will provide the least amount of difficulty in a synthetic phonics instructional context.

(G) Within the sequencing of consonant digraphs the consideration of blending ease (see E above) will be adhered to wherever possible.

SECTION IV
THE RULE SEQUENCE

Section IV presents the sequence of correspondence rules. To increase the usefulness of this work, alternative sequencing strategies were developed instead of a single, ordered set of rules. This approach is more compatible with the different uses to which this work is to be applied, e.g., phonics instruction, introduction of sight vocabulary and generation of story vocabulary. Consequently, three strategies were used in deriving the correspondence rule sequence:

(1) Consonants, primary vowels and secondary vowels sequenced in three separate lists--The manner of combining the three is left largely to the program developers (however, see p. 12).

(2) Within each list individual rules combined to form blocks--the blocks assume the function of molecular instructional units. Rules are combined into blocks for the following purposes:

(a) To promote generalization by rule across letters (e.g., Primary Vowels--Block II).

(b) To promote generalization through similarity in structure, e.g.,

1. Phonological similarity (e.g., Primary Vowels--Block IX).

2. Environmentally conditioned similarity (e.g., Primary Vowels--Block X).

3. Graphemic regularity--in some cases graphemic units had consistent pronunciations, regardless of environment (e.g., Consonants--Block I).

4. Graphemic structural similarity (e.g., Consonants--Block IV).

(c) To combine rules of similar occurrence or co-occurrence frequencies.

The blocks are the basic sequencing units for this project and are generally ordered by occurrence frequency. Within each block the rules are likewise listed by occurrence frequency. Whenever applicable, an alternative listing, which considers the blending ease of phonemic components, is given.

(3) Sequencing options--In a number of instances, alternate locations for a rule are designated by options. Three types of options were used:

(a) Option 1--the first position in the sequence that the rule could occupy.[5] Option 1 permits the use of a multiple-discrimination approach (see p. 9), proposed by Levin and Watson (1963 a, b) and Williams (1968). The introduction of multiple grapheme-phoneme correspondences aids in the induction of a set for variability.

(b) Option 2--the alternative position if Option 1 is not selected. Option 2 conforms to the major guidelines of sequence by occurrence frequency. This is the criterion most heavily relied upon by other writers (Black, 1961; Fry, 1963; Clymer, 1964; Bailey, 1967; Burmeister, 1967).

(c) Option 3--in some cases rules could be introduced anywhere beyond a designated point, at the program developer's discretion.

The following guidelines are offered to aid in sequencing between the lists (consonants, primary vowels, and secondary vowels):

(1) Inter-list sequencing contingencies--The pre-and co-requisite rules that apply across lists are identified (e.g., GH10 must precede or be concurrently presented with I24).

(2) Number of one-syllable, 6-7 age level words (see Appendix III, Table 3a)--For the most part these words comprise the initial reading vocabulary; therefore, rules for these words should appear before rules that apply predominantly in more difficult words. This information was stressed in the sequencing of secondary vowels.

(3) Inter-List Rule Sequence--Table A (p. 29) was prepared to aid in inter-list sequencing. Each list was divided into three segments. It is suggested that parallel segments be sequenced together.

A CONSONANT RULES

BLOCK (I) R10 T10 N10 L10 D10 P10 M10 B10 (S10-Option 1)[6]

These rules are high in frequency as well as in rule and grapheme regularity.

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[5] Option 1 refers to the first block in which a rule may appear. It does not indicate the authors' preference. When one option is superior to the other, this is stated in the text.

[6] All optional rules are enclosed in parentheses. Alternatively sequenced rules appear in brackets.

Consonant Rules (continued)

S10-Option 1--The S10 rule is introduced here because of its high occurrence frequency and easy blendability, although it is not as consistent in terms of grapheme regularity as the other rules in the block.

[S10 N10 M10 R10 L10 T10 D10 P10 B10]

This alternate within block sequence is based upon blending considerations.

(SS10-Option 1) (TT10-Option 3) (DD10-Option 3)

(PP10-Option 3) (MM10-Option 3) (LL10-Option 3)

(RR10-Option 3) (NN10-Option 3) (BB10-Option 3)

Geminate consonant clusters will be treated as special cases of the single consonant rules.[7] However, their introduction should be deferred because their occurrence is limited primarily to two-syllable words. Upon their appearance, at the discretion of the program developers, they will be referenced back to this rule instruction.

BLOCK (II) [F10 V10 H10 K10 W10]

These rules possess high rule regularity but their occurrence frequencies are not as high as the Block I rules. Block II rules also contain a lower percentage of one-syllable words (see Appendix III, Table 3a).

[F10 V10 H10 W10 K10]

This alternate within block sequence is based upon blending considerations.

(FF10-Option 3)

See explanation for geminate consonant clusters (Block I).

---

[7]Rules for geminate consonant clusters will probably be included with the single consonant rules in the first revision of the rules of correspondence.

Consonant Rules (continued)

BLOCK (III) (S10-Option 2) C12 (C11-Option 1) G12 (G11-Option 1)

Block III contains consonants with at least two predominant pronunciations. On a criterion of occurrence frequency rules C12 and G12 (the "hard" sounds) would have been introduced prior to this block; however, they do not possess the grapheme regularity of the first two blocks.

Inter-List Sequencing Contingencies--Before introducing C12 and G12 some of the A, O, and U rules should be presented.

S10-Option 2--There are several other S rules (S20, S21, and S31) thus warranting S10's inclusion into this block. The other three S rules will be deferred because they all have low occurrence frequency.

C11-Option 1 and G11-Option 2--C11 and G11 (the "soft" sounds) are to be introduced as contrasts to C12 and G12 at this time, if a strategy of multiple-rule discrimination is to be used.

Inter-List Sequencing Contingencies--Before the C11 and G11 rules are introduced, some of the E, I, and Y rules should be presented.

(SS10-Option 2) (CC12-Option 3) (GG10-Option 3)
See explanation for geminate consonant clusters (Block 1).

BLOCK (IV) SH10 CK10 CH10 (TCH10-Option 1) TH11 (TH12-Option 1)

(TH13-Option 1)

This block contains consonant digraphs (plus TCH10 which is the phonological equivalent of CH10).

TCH10-Option 1, TH12-Option 1, and TH13-Option 1--
These options have low occurrence frequencies, but high word usage frequencies, and can be introduced at this time as a contrast to the above rules.

Consonant Rules (continued)

The following high usage frequency words[8] contain these rules:

TCH10	TH12	TH13	
catch	brother	than	there
kitchen	either	that	these
watch	father	the	they
	mother	their	this
	other	them	those
	weather	then	

[SH10 TH11 (TH12-Option 1) (TH13-Option 1) CH10 CK10]

This alternate within block sequence is based upon blending considerations.

BLOCK (V) (C11-Option 2) (G11-Option 2) S20

The first two rules were referred to in Block III. They are placed here because of their high occurrence frequency. Also, they have many one-syllable 6-7 age level words.

BLOCK (VI) J10 Z10 QU10 X10 Y10

Like the rules of Blocks I and II the above display the same rule and grapheme regularity, but are far less frequent.

(ZZ10-Option 3)
See explanation for geminate consonant clusters (Block I).

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[8]The criterion used in this paper to designate words as high frequency was their being either:

(a) AA on the Thorndike-Lorge (1944) List and 2000 occurrences for grades one and two on the Rinsland (1945) List, or;

(b) A on the Thorndike-Lorge List and 1000 occurrences for grades one and two on the Rinsland List.

Consonant Rules (continued)

BLOCK (VII) NG10 N20 LE22

None of the above rules may occur in initial position. The NG10 and N20 rules have the same pronunciation. NG10 is employed in the formation of present participles (the -ing form); therefore, it may be useful to introduce this rule at an earlier point in the sequence. The pronunciation of N20 is an automatic phonological alternation; therefore, it probably should not be taught. LE22 occurs only in two-syllable words, which are, however, largely 6-7 age level words.

Intra-and Inter-List Sequencing Contingencies--Before the introduction of N20, at least some of the following rules should be presented: K10, G12, C12, QU10, and X10. General primary vowel Rule 16 should precede LE22 or appear concurrently with it.

BLOCK (VIII) WH10 PH10 (TH12-Option 2) (TH13-Option 2) (TCH10-Option 2)

The above low frequency rules all contain an H which serves as a marker for an altered pronunciation.

TH12-Option 2 and TH13-Option 2--These low-frequency rules may be taught at this point, although several high usage frequency words will probably have been introduced as sight words (see Block IV).

TCH10-Option 2--If taught at this time, TCH10 will be referenced back to CH10 (Block IV).

BLOCK (IX) GH10 L20 T20 H20 K20 W20 B20

In each of the above rules, the grapheme unit is not pronounced.

Inter-List Sequencing Contingencies--023 and A23 should be presented before the introduction of L20. Prior to the introduction of T20, E17 should be presented.

Consonant Rules (continued)

MISCELLANEOUS S31 S21 CH31 G31

The above rules are considered miscellaneous because each has low occurrence frequency; and there are no reasons to warrant their location at any point within the sequence. Because of their low occurrence frequency, they need not be taught as rules. The high-frequency words which contain these rules are listed below. They will most likely have been taught as sight words by this time.

S31	S21	CH31	G31
news	house	school	begin
always		Christmas	finger
clothes			forget
does			get
goes			girl
			give

B PRIMARY VOWEL RULES

BLOCK (I) I15 A15 E15 U15 O15

The rules above are the five cases of what is generally referred to as the "short-vowel" rule. Due to their similar environments they can be taught together, generalizing across letters by rule.

BLOCK (II) E18 A11 I11 O11 U11 E11 (O25-Option 1) (E25-Option 1) (Y19-Option 1) (A29-Option 1)

The 11 rules are commonly referred to as the "final-e" rule. As in Block I, the rules of Block II have similar environments and thus it is possible to generalize the rule across individual letters.

O25-Option 1, E25-Option 1, and Y19-Option 1--The three rules above, which have high rule regularity, represent long vowel sounds in final position. The following words containing these rules are one-syllable, 6-7 age level words of high usage frequency:

Primary Vowel Rules (continued)

025	E25	Y19
go	be	by sky
no	he	cry try
so	me	dry why
	she	fly
	we	my

A29-Option 1--A29 has the same phonological representation as A11, but occurs in a very restricted environment:

$$A29\ a \rightarrow [e] \ /__ \begin{Bmatrix} nge \\ ste\# \end{Bmatrix}$$

Inter-List Sequencing Contingencies--The following rules should be introduced prior to A29: S10, T10, N10, and G11.

Note: Blocks III-V provide for the introduction of bisyllabic words by the following steps:

(1) Introduction of the 21 rules in monosyllabic words (Block III);

(2) Bisyllabic words introduced using the 16 rules (an extension of the "short-vowel" rule) in conjunction with E21. This step permits the introduction of bisyllabic words without using the concept of stress (Block IV);

(3) Introduction of the 17 rules in bisyllabic words with the first syllable stressed. This generalizes from Step 2 where all words have the first syllable stressed (Block V);

(4) Introduction of the 17 rules in bisyllabic word with the second syllable stressed (Block V).

BLOCK (III) E21 A21 O21 I21 (A25-Option 1) (A22-Option 1) (O22-Option 1)

The 21 rules of Block III are generally referred to as the "vowel-r" rules. They all have 100% co-occurrence with R10 in the environment $__ \begin{Bmatrix} r \\ r\# \end{Bmatrix}$. There are many high usage

Primary Vowel Rules (continued)

frequency words containing these rules. As with the first and second primary vowel blocks, the 21 rules may be generalized across letters.

A25-Option 1--This unproductive rule is a consistent exception to A21, being marked by either w or u before the a. This rule can be introduced here following a multiple-rule discrimination strategy, contrasting it against A21.

Inter-List Sequencing Contingencies--The following rules should precede, or be concurrently introduced with A25, W10, QU10, and R10.

A22-Option 1--This unproductive rule is an alternative to A21--it is represented:

A22 a → [ɛ], [æ]/__r.

The A22 rule may be introduced here as a contrast to A21 at this time. In sequence, A22 is used when A11 and A21 are not applicable.

022-Option 1--This unproductive rule is an alternative to 021--and is represented:

022 o → [ə]/w__rC.

The 022 rule may be introduced here as a contrast to 021 at this time. 022 is to be used when 021 is not applicable.

BLOCK (IV) I16 A16 U16 E16 016 (Y15-Option 3)

The 16 rules are an extension of the "short-vowel" rule (Rule 15-Block I) and mark the onset of regular inclusion of two-syllable words. The 16 rules also may be generalized across letters in instruction.

Y15-Option 3--Because of their low productivity as individual rules, Y15 and Y16 were collapsed to Y15. This rule may be added anywhere after this point.

Primary Vowel Rules (continued)

BLOCK (V) Y17 A17 E17 017 (I17-Option 3) (U17-Option 3)

The 17 rules are generally referred to as the "unstressed-syllable" rule. The above rules (except Y17) reduce to [ə] or [I] when in the unstressed position of a two-syllable word.

I17-Option 3, U17-Option 3--I17 and U17 are low-productivity rules. Their inclusion at this point, which is recommended, would serve to demonstrate the generalizability of this rule across five letters.

BLOCK (VI) E13 013 A13 I13 U13

The 13 rules are an extension of the "final-e" rule (Rule 11--Block II). Their position is analogous to the 16 rules for short vowels. These rules generalize across individual letters.

BLOCK (VII) (a) (A12-Option 3) (I12-Option 3) (012-Option 3) (U12-Option3)

(b) (E14-Option 3) (I14-Option 3) (A14-Option 3) (014-Option 3) (U14-Option 3)

(c) (Y11-Option 3)

(a) and (b) above are low-productivity rules, but may be generalized across individual letters. They are extension of the "long-vowel" rule and are included at this point in order to extend the generalizability of the 11 and 13 rules. (a) and (b) may be employed at any location in the sequence after this point.

Inter-List Sequencing Contingencies--Before the introduction of the 12 vowel rules, R10 and LE22 should be presented. Before the 14 vowel rules, R10 and L10 should be introduced.

Y11-Option 3--Y11 represents the collapse of Y11, Y12, Y13, and Y14 into one rule, because of their low productivity. Y11 may be included anywhere in the sequence after this point.

Primary Vowel Rules (continued)

BLOCK (VIII) O31 U31

The above rules defy environmentally-conditioned descriptions. They are included here because of their high occurrence frequencies to provide an alternative when the two major vowel patterns are not applicable.

BLOCK (IX) I24 I22

The above are exceptions to the I15 and I16 rules; however they occur in very restrictive environments:

I24 i → [ay] /__ {gh}

I22 i → [ay] /__ $\begin{Bmatrix} nd \\ ld \\ gn \end{Bmatrix}$ #

Within these environments, they have high rule regularity, and are contained in the following high usage frequency words.

I24		I22	
bright	might	behind	mind
fight	night	child	wild
high	right	find	wind (V)
light	tonight	kind	

Inter-List Sequencing Contingencies--Rule GH10 should precede, or be presented concurrently with, the introduction of I24. The introduction of I22 should be preceded by N10, L10, and D10.

BLOCK (X) A23 O23

Both 23 rules are conditioned by consonant clusters beginning with L:

A23 a → [ɔ]/__ $\begin{Bmatrix} l\underset{\cdot}{l} \\ lk \\ lt \\ ld \end{Bmatrix}$

O23 o → [ɔ]/__lC#.

Within this context they have high rule regularity.

Primary Vowel Rules (continued)

BLOCK (XI) (025-Option 2) (E25-Option 2) (Y19-Option 2)

Useful words containing these rules will have been taught as sight words if the above rules are introduced here rather than earlier in the sequence. Thus it is strongly recommended that they be introduced in or shortly after Block II.

BLOCK (XII) (I26-Option 1) (U26-Option 1) (E26-Option 1) (026-Option 1)

If 025 and E25 are introduced as Option 2, then the 26 rules, which have long-vowel sounds, are to be included at this point. The 26 rules represent the long-vowel sound before a syllabic boundary, followed by another vowel. The first vowel in this case would be the same as in the 25 rules.

BLOCK (XIII) E38 I38 A38 038

The above rules are exceptions to the primary vowel rules 11-14, functioning more like the 16 rules. Each 38 rule occurs within the following environment:

$$/__ \begin{Bmatrix} vV \\ x(1)V \end{Bmatrix}$$

The 38 rules can be generalized across all four letters.

Inter-List Sequencing Contingencies--The following consonant rules should be introduced before the 38 rules: V10, X10, and L10.

BLOCK (XIV) E32 (032-Option 3) (A32-Option 3) (I32-Option 3) (U32-Option 3)

The above rules function in more of a classificatory capacity than as a set of correspondence rules. E32 had 30 exemplars and may be taught as a rule. The other four rules have a total of 10 exemplars and probably should not be taught as rules. (See Appendix I, p. 31, for discussion the rule-set inclusion criteria applied to low productivity rules.)

Primary Vowel Rules (continued)

BLOCK (XV) (I26-Option 2) (U26-Option 2) (E26-Option 2) (O26-Option 2)

If the 25 rules are introduced as Option 1, then the 26 rules belong here.

MISCELLANEOUS O24 E19 (A25-Option 2) A24 (A22-Option 2) (A29-Option 2) I25 (O22-Option 2) U20

These rules have no apparent place within the rule sequence (except where Option 1 was used). An explanation for this decision is given below for each rule. Accompanying each explanation is a list of high usage frequency words that contain the rule.

O24

This rule is pronounced [ɔ] or [a] in a multitude of environments. This rule was not introduced earlier in the sequence because of its environmental complexity. The high usage frequency words containing this rule are:

across, along, cost, cross, dog, long, lost, off, office, often, soft, song, strong, wrong.

E19

This rule is related to E18 and is used with inflected forms. E19 should be preceded by or taught concurrently with S31 and D10. The following high usage frequency words contain this rule:

clothes, tired.

(A25-Option 2)

This unproductive rule was introduced previously (Block III) following the 21 rules. If that position is not exercised, there is no apparent position within the sequence for A25 to occupy. It is an exception to both the A21 and A24 rules. There are no exemplars of this rule that reach the criterion for high usage frequency.

Primary Vowel Rules (continued)

A24

This unproductive rule has two alternate pronunciations (with dialectal and individual variations). The following high usage frequency words contain this rule:

want, watch, water.

(A22-Option 2)

If this rule is not taught after A21, then it has no appropriate position within the sequence of rules. The low productivity and the negative transfer engendered by the instruction of this rule appear to warrant its exclusion from instruction as a rule. There are no exemplars of this rule that reach the criterion for high usage frequency.

(A29-Option 2)

If this rule is not taught after A11, there is no apparent position for A29 to occupy. It is an exception to A16, and occurs in very limited environments. The following high usage frequency words contain this rule:

change, taste.

I25

This unproductive rule is similar to rules included on the E (ending) list (see Berdiansky, Cronnell and Koehler, 1969, pp.54-55) but the decision was made to include it as a rule, because it does not involve a change in the preceding consonants and the I can be mapped consistently to [y]. There are no exemplars of this rule that reach the criterion for high usage frequency.

(O22-Option 2)

O22 is an exception to the O21 rule. If it is not taught in Block III as a contrast to O21, the words exemplifying these rules will probably be taught as sight words. The following high usage frequency words contain O22:

word, work, world.

Primary Vowel Rules (continued)

U20

This is one of the least productive rules within the primary vowel rule list. The reason for its inclusion in the rule set was to reduce the number of rule exceptions. There is only one high usage frequency word containing U20:

g<u>u</u>ess.

C SECONDARY VOWEL RULES[9]

BLOCK (I) EE10

This is the second most productive secondary vowel rule, having few exceptions, and therefore is included as the first secondary vowel rule. It has 177 exemplars, 85 of which are monosyllabic, 6-7 age level words.

BLOCK (II) EA11 (EA31-Option 1)

This is the most productive secondary vowel rule and should be taught next. There are 214 exemplars of this rule, 102 of which are monosyllabic, 6-7 age level words.

EA31-Option 1--This rule may be inserted here if the strategy of multiple-rule discrimination is followed. EA31 has 24 monosyllabic, 6-7 age level words.

BLOCK (III) AI10 AY10 (AI17-Option 1)

AI10 and AY10 both are pronounced [e] and are in complementary distribution; i.e., AI10 occurs initially or medially and AY10 occurs finally.

AI17-Option 1--AI17 may be introduced in contrast to AI10. There are only nine words containing AI17.

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[9]The number of one-syllable, 6-7 age level words (See Appendix III, Table 3a) was included whenever such information was useful. This should aid in decisions to sequence secondary vowel rules with consonant and primary vowel rules.

Secondary Vowel Rules (continued)

BLOCK (IV) OU10 OW12 (OW11-Option 1)

OU10 and OW12 are pronounced [aw] and have high productivity. OU10 has 121 exemplars, 44 of which are monosyllabic, 6-7 age level words. OW12 has 56 exemplars.

OW11-Option 1--This rule may be introduced along with OW12. There are 26 monosyllabic, 6-7 age level words containing OW11.

BLOCK (V) OO11 (OO12-Option 1)

OO11 is slightly less productive than the rules in preceding blocks. It has 117 exemplars, 56 of which are one-syllable, 6-7 age level words.

OO12-Option 1--As with the graphemic unit OW, OO has two predominant pronunciations. OO12 can be sequenced concurrently with OO11 for contrastice purposes. OO12 has 21 monosyllabic, 6-7 age level words.

BLOCK (VI) OA10 (OW11-Option 2)

OA10 and OW11 both are pronounced [o]. It is recommended that OW11 be included at this point in order to take advantage of the phonological similarity with OA10. OA10 is a productive rule having 70 exemplars, 36 of which are one-syllable, 6-7 age level words. OW11 has 69 exemplars, 26 of which are one-sullable, 6-7 age level words.

BLOCK (VII) AW10 AU10

Both rules are pronounced [ɔ] and have high rule regularity. AW10 has 42 exemplars, 23 of which are monosyllabic, 6-7 age level words. AU10 has 37 exemplars, 11 of which are monosyllabic, 6-7 age level words.

BLOCK (VIII) (EA31-Option 2) (OO12-Option 2)

EA31 is a very productive rule with 61 exemplars, 24 of which are monosyllabic, 6-7 age level words. Likewise, OO12 is also a very productive rule with 49 exemplars, 21 of which are monosyllabic, 6-7 age level words. Because

Secondary Vowel Rules (continued)

of their high occurrence frequencies and large number of high usage frequency words, these rules should appear relatively early. The following high usage frequency words contain these rules:

EA38		0012	
bear	heavy	book	look
bread	read (past)	cook	stood
breakfast	ready	foot	took
dead	tear (V)	good	wood
head	wear		
health	weather		

BLOCK (IX) 0010 0Y10

The two rules above are pronounced [oy]. They are in complementary distribution; i.e., 0I10 occurs either initially or medially and 0Y10 occurs finally. 0I10 has 36 exemplars and 0Y10 has 22. Combined, they have 18 monosyllabic, 6-7 age level words.

BLOCK (X) EW10 UE10 OU33 UI10

The four rules above are pronounced [y(u)]. Taken together they have 97 exemplars. EW10 has 18 and UE10 has 11 monosyllabic, 6-7 age level words. These rules should be taught as a set of graphemic contrasts with the same pronunciation.

BLOCK (XI) IE12 EY17 EI10 IE17

The above rules are pronounced [i]. Generalization of phonological similarity should be emphasized. The four rules have a total of 89 exemplars.

BLOCK (XII) OU35 OE10

Both rules are pronounced [o]. They have a combined total of 33 exemplars including 11 monosyllabic, 6-7 age level words containing OU35 and 5 monosyllabic, 6-7 age level words containing OE10. The following high usage frequency words contain OU35: course, four.

Secondary Vowel Rules (continued)

BLOCK (XIII) OU31

This rule has 34 exemplars, only five of which are monosyllabic, 6-7 age level words. However, several of the words containing OU31 have high usage frequencies:

country, cousin, enough, trouble, young.

BLOCK (XIV) EI20 EY10

Both rules are pronounced [e]. They are in complementary distribution; i.e., EI2- occurs either in initial or medial position, and EY10 occurs only in final position. The two rules have a total of 22 exemplars.

MISCELLANEOUS EA33 OU34 IE11 (AI17-Option 2) UI31

These five rules range in productivity from 7 to 15 exemplars. To a large extent they are exception rules and probably should not be taught as correspondence rules. The following high usage frequency words contain these rules; they probably will be treated as sight words:

EA33	OU34	IE11	AI17	UI31
early	bought	die	mountain	build
earth	brought	lie		building
heard	thought	tie		built
learn				

Table A: Inter-List Rule Sequence

CONSONANTS	PRIMARY VOWELS	SECONDARY VOWELS
BL 1 R10,T10,N10,L10,D10,P10,M10,B10,(S10-Opt 1), (SS10-Opt 1,TT10-Opt 3,DD10-Opt 3,PP10-Opt 3, MM10-Opt 3,LL10-Opt 3,RR10-Opt 3,NN10-Opt 3, BB10-Opt 3)	BL 1 I15,A15,E15,U15,O15	BL 1 EE10
BL 2 F10,V10,H10,K10,W10,(FF10-Opt 3)	BL 2 E18,A11,I11,O11,U11,E11,(O25-Opt 1), (E25-Opt 1), (Y19-Opt 1), (A29-Opt 1)	BL 2 EA11,(EA31-Opt 1)
BL 3 (S10-Opt 2),C12,(C11-Opt 1),G12,(G11-Opt 1) (SS10-Opt 2,CC12-Opt 3, GG10-Opt 3)	BL 3 E21,A21,O21,I21,(A25-Opt 1),(A22-Opt 1), (O22-Opt 1)	BL 3 AI10,AY10,(AI17-Opt 1)
BL 4 SH10,CK10,CH10,(TCH10-Opt 1),TH11,(TH12-Opt 1), (TH13-Opt 1)	BL 4 I16,A16,U16,E16,O16,(Y15-Opt 3)	BL 4 OU10,OW12,(OW11-Opt 1)
BL 5 (C11-Opt 2),(G11-Opt 2),S20	BL 5 Y17,A17,E17,O17,(I17-Opt 3),(U17-Opt 3)	BL 5 OO11,(OO12-Opt 1)
BL 6 J10,Z10,QU10,X10,Y10,(ZZ10-Opt 3)	BL 6 E13,O13,A13,I13,U13	BL 6 OA10,(OW11-Opt 2)
BL 7 NG10,N20,LE22	BL 7 (A12-Opt 3,I12-Opt 3,O12-Opt 3,U12-Opt 3), (E14-Opt 3,I14-Opt 3,A14-Opt 3,O14-Opt 3, U14-Opt 3),(Y11-Opt 3)	BL 7 AW10,AU10
		BL 8 (EA31-Opt 2),(OO12-Opt 2)
		BL 9 OI10,OY10
BL 8 WH10,PH10,(TH12-Opt 2), (TH13-Opt 2),(TCH10-Opt 2)	BL 8 O31,U31	BL 10 EW10,UE10,OU33,UI10
BL 9 GH10,L20,T20,H20,K20,W20,B20	BL 9 I24,I22	BL 11 IE12,EY17,EI10,IE17
MISC S31,S21,CH31,G31	BL 10 A23,O23	BL 12 OU35,OE10
	BL 11 (O25-Opt 2),(E25-Opt 2),(Y19-Opt 2)	BL 13 OU31
	BL 12 (I26-Opt 1),(U26-Opt 1),(E26-Opt 1),(O26-Opt 1)	BL 14 EI20,EY10
	BL 13 E38,I38,A38,O38	MISC EA33,OU34,IE11,(AI17-Opt 2),UI31
	BL 14 E32,(O32-Opt 3),(A32-Opt 3),(I32-Opt 3), (U32-Opt 3)	
	BL 15 (I26-Opt 2),(U26-Opt 2),(E26-Opt 2),(O26-Opt 2)	
	MISC O24,E19,(A25-Opt 2),A24,(A22-Opt 2,(A29-Opt 2), I25,(O22-Opt 2),U20	

APPENDIX I
SPELLING-TO-SOUND CORRESPONDENCE RULES[10]

This section of the report concerns the spelling-to-sound correspondence rules used in the project. The conceptualization involved in the selection of the rule is discussed first. The major part of the section presents the complete set of rules, along with an explanation of the symbols used and descriptions of the content of the rules. The section concludes with a Key to Pronunciation (p. 51).

Selection of Spelling-to-Sound Correspondence Rules

The spelling-to-sound correspondence rules are based on the work of Venezky and Weir, with additional information from Wijk. Venezky has described the spelling-to-sound correspondences for a 20,000-word vocabulary; because the rules used here are applied to the one- and two-syllable words of a smaller lexicon, not all of his rules are applicable (see below).

Venezky claims that a direct correspondence between spelling and sound cannot always be made; thus he incorporates a morphophonemic level between the graphemic and phonemic representations. For example, tion would go through the morphophonemic level, //tyon//, and then to the pronunciation [šən].* While useful and perhaps necessary for descriptive purposes, this level is generally too complex for use in teaching and has not been employed in this study, which instead proceeds directly from spelling to sound. However, two of Venezky's related contributions to a description of grapheme-phoneme relationships have been incorporated into this presentation: the use of stress and morphological information. Knowledge of stress is necessary for the pronunciation of unstressed vowels; therefore, stress is indicated for all rule-processed words. For example, the stressed a in acorn is

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[10]This is Section III of Berdiansky, Cronnell and Koehler (1969).

*See Key to Pronunciation (p. 51) for explanation of phonetic symbols used in this report.

is pronounced [e] (Rule A13, p. 38), while the unstressed a in about is pronounced [ə], the usual pronunciation of unstressed vowels (see p. 35). Moreover, one spelling is sometimes pronounced in two ways for two different form classes, depending on stress. For example, conflict (verb) is stressed on the second syllable, giving the first vowel the unstressed pronunication [ə]; but conflict (noun) is stressed on the first syllable, giving the first vowel the pronunication [a] (Rule 016, p. 41).

Morphological considerations are often crucial to the interpretation of derived forms, and this has been taken into consideration by indicating boundaries between base forms and endings when this knowledge is necessary for correct rule interpretation. For example, the second b in bomber is silent according to Rule B20 (p. 45)--as in bomb--if a morpheme boundary is recognized within the word; in bombard there is no boundary after the second b, so it is pronounced. Syllable division has also been indicated when this knowledge is necessary for correct rule interpretation. For example, the ph in shepherd is not irregular (ph is regularly pronounced [f] by Rule PH10, p. 48), so long as a syllable division is recognized--shep-herd--giving separate pronunciation to both p and h.

The present rules apply to the following kinds of grapheme units: (1) single letters (e.g., a, x); (2) consonant digraphs (e.g., ch, th) and secondary vowels (e.g., ea, oy); (3) strings of letters which commonly function together as units (e.g., ck, le); (4) double consonants (e.g., bb, ff).

In general, the criterion for defining a rule was its productivity: a rule was included when it had at least 10 exemplars. Rules which did not meet this criterion were included when they were part of general rules concerning all primary vowels (e.g., Rules I12, 032; see below, p. 34 ff). Moreover, when a particular grapheme unit was uncommon in the lexicon (e.g., oe), a rule was still included so that there would be at least one rule for each grapheme unit. In addition, a few unproductive rules (e.g., Rule E25) were included when the words to which they applied occurred frequently in the language.

A rule which is not productive in the present vocabulary may be more productive in the language as a whole; these potentially productive rules have been included in this study. There are other rules, however, which have not been included, but which may be productive enough to be included when the lexicon is expanded.

Another criterion for rule selection was that the number of exceptions should be kept to a minimum. After the initial rule processing of the words, an examination was made of exceptions. This permitted elimination of some exceptions by adding more rules, giving a total of 166 rules, with less than 800 exceptions yet unclassified. While the number of rules may seem large, many of them are generalizable across letters (e.g., Primary Vowel Rules 11-17, pp. 34-36), even though they have been stated individually for clarity and convenience.

Some rules that had little applicability to elementary reading instruction were not included in this study. For example, the palatalization rules can account for such pronunciations (see underlined letters) as so<u>ci</u>al, mi<u>ssi</u>on, ac<u>ti</u>on, pic<u>tu</u>re. Such rules have at least two parts and were considered too complex for elementary school (or even older) children. Moreover, they are difficult to generalize, since they do not occur commonly enough in two-syllable words (although they are more frequent in longer words). Words containing such palatalizations are treated separately.* It is believed that expansion of the present vocabulary, while adding additional rules and eliminating some exceptions, will not necessitate the removal of any of the present rules, although a few may require some modification.

A Listing and Description of Rules

I. Description of the notational system

The spelling-to-sound correspondence rules are given in a concise notational system. Additional explanation is provided where useful. Examples of words employing each rule are given with the illustrated grapheme unit underlined.

An arrow (→) means "is pronounced as." To the left of the arrow is the grapheme unit; to the right of the arrow is the pronunciation, enclosed within brackets ([ ]) and indicated by phonetic symbols (explained in the Key to Pronunciation, p. 51). For example,

m → [m]

is read, "The letter <u>m</u> is pronounced as the sound [m]."

When a particular pronunication is dependent on a particular environment, this environment is given after a slash (/) following the pronunciation. In the description of the rules, the following symbols are used:

1. ___ : the position of the grapheme unit covered by the rules;
2. C : any consonant (including consonantal <u>w</u> and <u>y</u>);
3. V : any vowel (including vocalic <u>y</u>);
4. $\bar{V}$: the long pronunciation of a vowel (i.e., [e, i, ay, o, yu]);

*See Berdiansky, Cronnell and Koehler (1969), pp. 41, 48-49, 54-57.

5. $\breve{V}$: the short pronunciation of a vowel (i.e., [æ, ɛ, I, ɑ, ə]);

6. Ø : a silent pronunciation of a vowel (e.g., e → Ø in home);

7. ( ) : optional (may or may not be present);

8. { } : any of the letters or symbols within these braces may occur in this position;

9. - : syllable division (e.g., be-yond, bin-go, ri-ot), indicated when necessary for rule clarification;

10. # : word/morpheme boundary (the beginning or end of a word/morpheme, e.g., #book#; this may occur within compounds and derivations (e.g., in golden there is a boundary after gold).*

For example, a → [a] /__$\{^{rC}_{r\#}\}$ is read, "The letter a is pronounced as the sound [a] when it is followed either by the letter r and a consonant or by the letter r at the end of a word."

Rules numbered 10 to 19 are major--most productive and general--spelling-to-sound correspondences.** A Rule 10 (used with consonants and secondary vowels; e.g., J10, EE10) indicates that the grapheme unit has few other rules and few exceptions. When a grapheme unit had one major rule, but numerous other rules and/or exceptions, it was numbered 11 (e.g., EA11); when a grapheme unit had two major rules, both common and productive, they were numbered 11 and 12 (e.g., C11 and 12; OW11 and 12). (This does not include primary vowels, where there is a much larger number of rules.) Rules numbered 20 to 29 are minor--less productive and general--spelling-to-sound correspondences.

If, after major and minor rules were accounted for, there was a large number of exceptions for a grapheme unit, they were grouped into rules by their pronunciation; these major classes of exceptions are numbered 30 to 39 (e.g., G31; OU31, 33, 34, 35; general primary vowel exception Rules 32 and 38, see pp. 36-37). All other exceptions are marked as Rule 40. No Rule 40 is included in the following rule descriptions, because each Rule 40 involves more than one correspondence.

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*In coding the present lexicon, medial morpheme boundaries were marked in the same way as syllable divisions (see Berdiansky et al., 1969, pp. 40-41).

**Because of rule revisions during the coding process, the rule numbers are not entirely consistent for all grapheme units. Rule numbering will be revised and standardized when the lexicon is expanded.

When the same kind of rule applies to more than one grapheme unit, it is given the same number (e.g., Rules for silent letters are generally numbered 20; see also below).

II. Vowels

A. Introduction

1. Primary and secondary vowels. These terms (from Venezky, 1967) indicate single letter vowels (a, e, i, o, u, y) and vowel digrams (e.g., ea, oi, ue), respectively.

2. General primary vowel rules. Ten of the primary vowel rules (Rules 11-17, 26, 32, 38) are generalizable across all primary vowels, except y.* They are described in general terms below and in Tables A and B (pp. 54-55). However, in the correspondence rules which follow, they are listed separately for each vowel.

   a. Long-vowel rules (see Table A, p. 54). The generalized form of the long-vowel rule is:

   $$V \rightarrow [\bar{V}] / __ C(\{^{r}_{l}\})\ V;$$

   that is, a primary vowel is pronounced as its long sound when it is followed by a consonant (and an optional r or l) and a vowel (see the Rule for Y11, p. 42). In order to show the major ways in which this general rule applies, it has been divided into four parts, rules numbered 11 to 14.

11. $V \rightarrow [\bar{V}] / __ Ce\#$ This is the usual long vowel rule, generally applicable in one syllable words, with the final silent e. Examples: name, scene, fine, home, tune.

12. $V \rightarrow [\bar{V}] / __ C\{^{r}_{l}\}e\#$ This is an extension of Rule 11, but with r or l between the consonant and the final e. Examples: acre, stable, title, orge, noble, bugle.

13. $V \rightarrow [\bar{V}] / __ CV$ This is also an extension of Rule 11, but it applies when any vowel follows the consonant

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*General primary vowel Rules 11-14 and 15-16 are generalizable to y; however, because of low productivity, they have been collapsed into Y11 and Y15 respectively (see p. 42). When the lexicon is expanded, these rules will be subdivided as they are now for the primary vowels (see pp. 34-35).

and to e when not in final position. Examples: baby, native, hero, meter, pilot, cider, notice, moment, unit, crusade.

14. $V \rightarrow [\overline{V}]/___C\{^{r}_{l}\}V$ This is an extension of Rule 13, similar to Rule 12. Examples: zebra, declare, migrate, okra, only.

There are at least two major ways in which the long-vowel rules may be generalized: (1) each rule, 11 through 14, may be generalized across all primary vowels; (2) Rules 11 through 14 may be collapsed into the general pattern given above for each primary vowel.

b. Short-vowel rules (see Table A, p. 54). The generalized form of the short-vowel rule is:

$$V \rightarrow [\breve{V}]/___\{^{CC}_{C\#}\};$$

that is, a primary vowel is pronounced as its short sound when it is followed either by two consonants or by one consonant at the end of a word (see the rule for Y15, p. 42). This general rule has also been divided into Rules 15 and 16.

15. $V \rightarrow [\breve{V}]/___C(C)\#$ This rule applies when the vowel is followed by one or two consonants at the end of a word. Examples: sat, fast, set, felt, sit, milk, hot, lock, gum, fuss.

16. $V \rightarrow [\breve{V}]/___CC\ldots$ This rule applies when the vowel is followed by at least two consonants in the middle of a word. Examples: saddle, edge, hidden, motto, sudden.

There are at least two major ways in which the short-vowel rules may be generalized: (1) each rule, 15 and 16, may be generalized across all primarly vowels; (2) Rules 15 and 16 may be collapsed into the general pattern given above for each primary vowel.

c. Primary vowels in unstressed syllables. Primary vowels (other than y) in unstressed syllables are most generally pronounced [ə](schwa). However, they are sometimes pronounced [I]; thus both pronunciations are given in the rules (see Table A, p. 54). The differences in pronunciation vary from word to word and from speaker to speaker.

Rule 17 (the unstressed vowel rule) has not been used in classifying words with primary vowels for these two cases: when [ə] or [I] is not the pronunciation of the unstressed vowel; for u when a schwa pronunciation can be obtained by using Rules 15 or 16 (e.g., supply). Stress is indicated for all one- and two-syllable words so that the unstressed-syllable rule can be applied when applicable. The above comments apply only to a, e, i, o, and u; y and secondary vowels have different pronunciations in unstressed syllables.

When unstressed [ə] or [I] occur in the following environment

$$/ \begin{Bmatrix} t \\ d \\ n \\ l \end{Bmatrix} __ \begin{Bmatrix} n \\ l \end{Bmatrix} \#,$$

they are often not pronounced, making the final consonant syllabic; e.g., sudden [sədn̩], little [lɪtl̩] ([n̩] and [l̩] indicate syllabic [n] and [l]).

d. Other general primary vowel rules (see Table B, p. 55).

General primary vowel Rule 26, V → [$\bar{V}$] /___-V (where "-" indicates syllable division), states that when a vowel occurs at the end of a syllable, the first vowel has its long pronunciation. (The syllable division is used to indicate that the two vowels are separate and not part of a secondary vowel pair.) Examples: chaos, create, liar, poem, fluid.

There are a number of words in English which basically have three syllables; however, the middle vowel (which is unstressed) is generally not pronounced, and the result is a word with two syllables. These words have been processed as two-syllable words, but they all have an alternate pronunciation--with the vowel--and so have been marked P. These usually silent vowels are described by general primary vowel exception Rule 32: V → Ø. Examples: diamond, several, aspirin, sophomore, natural.

Because of restrictions on the use of English letters, x can never be doubled and v can rarely be doubled (only in four words, none of which are in the present lexicon: divvy, flivver, navvy, savvy). The grapheme unit x always functions as a consonant cluster and thus a primary vowel preceding it always has its short pronunciation (Venezky, 1967). Because v is not generally doubled, the VvV pattern applies to both the short and long pronunciations of the first vowel. General primary vowel Rule 38 concerns the short pronunciation of primary vowels before xV and vV:

$$V \rightarrow [\breve{V}] / __ \begin{Bmatrix} vV \\ x(1)V \end{Bmatrix}.$$

Examples: cavern, axle, clever, exit, civic, river, novel, oxen, buxom.

3. Pronunciation. Webster's Seventh New Collegiate Dictionary (1965) was used as the source of pronunciation in this report. The Key to Pronunciation follows the rules (p. 51).

As noted above (p. 35), there are variations in the pronunciation of unstressed vowels. There are also dialect and personal variations in the pronunciation of other specific rules, particularly when the vowel precedes r. These common variations in rule pronunciation are indicated by giving more than one pronunciation in the rule (e.g., 021, WH10). Where such variations are possible, a particular speaker will generally use one pronunciation for all examples of the rule.

The "long-u" sound is either [u] or [yu]; e.g., as in moo and few. When following [r] or [l], it is always [u]; when following [t,d,s,z,š,ž,č,ǰ,n] it is generally [u], although there is some dialect variation. When following other consonants and vowels, it is generally [yu]; when word-initial it is always [yu]. In the following rules all such variation is expressed by writing the pronunciation as [(y)u], except in Rule 0011, where [u] is the only pronunciation.

As indicated above (p. 36), three-syllable words which may have a silent vowel making them two-syllable words were processed under primary vowel Rule 32 and marked P to indicate an alternate pronunciation. In addition, the symbol P has been used with other individual words with idiosyncratic alternate pronunciations not

covered by a rule (e.g., either [iðər] or [ayðər]; route [rut] or [rawt].

B. Spelling-to-sound correspondence rules for primary vowels*

Grapheme Unit	Rule #	Rule Description & Comment	Examples
A	11	a → [e] /_Ce#	name, brave
	12	a → [e] /_C{r, l}e#	acre, stable
	13	a → [e] /_CV	baby, nature
	14	a → [e] /_C{r, l}V	April, fragrant
	15	a → [æ] /_C(C)#	sat, fast
	16	a → [æ] /_CC....	saddle, jacket
	17	a → [ə], [I] in unstressed syllables	above, final
	21	a → [a] /_{rC, r#}	cart, car
	22	a → [ɛ], [æ]/_r Rule A22 is used when neither A11 nor A21 applies.	vary, marry
	23	a → [ɔ] /_{ll, lk, lt, ld} There is some dialect variation here.	ball, walk, salt, bald
	24	a → [a], [ɔ]/ {w, u}__ This rule applies only when the following consonant is not k, g, ng, or x.	wad, squat

*For 69 grapheme types, a total of 166 rules were identified: 60 consonant rules, 73 primary vowel rules, 33 secondary vowel rules. The phonemic correspondents for 45 grapheme types were not identified, i.e., Rule 40s.

Grapheme Unit	Rule #	Rule Description & Comment	Examples
A	25	a → [o] / $\left\{\begin{matrix}wh\\w\\u\end{matrix}\right\}$__r	wharf, war, quart
	29	a → [e] / __ $\{^{nge}_{ste\#}\}$	strange, paste
	32	a → Ø	separate
	38	a → [æ] / __ $\{^{vV}_{x(1)V}\}$	cavern, axis axle
E	11	e → [i] / __Ce#	scene, here
	13	e → [i] / __CV	hero, meter
	14	e → [i] / __C$\{^{r}_{l}\}$V	zebra, declare
	15	e → [ɛ] / __C(C)#	set, felt
	16	e → [ɛ] / __CC....	edge, extra
	17	e → [ə], [ɪ] in unstressed syllables	hidden, talent, magnet
	18	e → Ø / __# That is final e is silent (except when part of a secondary vowel).	name, edge, immense, mice
	19	e → Ø / __$\{^{s}_{d}\}$ This rule applies when ed or es is a past tense or plural form (and not pronounced [Id] or [Iz]), whether or not there is a simple verb or singular form (cf. Rule S31).	armed, wives
	21	e → [ə] / __$\{^{rC}_{r\#}\}$	herd, father
	25	e → [i] /#(C)C__# This rule applies to one-syllable words.	we, she

Grapheme Unit	Rule #	Rule Description & Comment	Examples
E	26	e → [i] /__-V	cr<u>e</u>-ate, m<u>e</u>-ow
	32	e → Ø	diff<u>e</u>rence, sev<u>e</u>ral
	38	e → [ɛ] /__$\{^{vV}_{x(1)V}\}$	cl<u>e</u>ver, <u>e</u>xit
I	11	i → [ay] /__Ce#	f<u>i</u>ne, l<u>i</u>ke
	12	i → [ay] /__C$\{^{r}_{l}\}$e#	t<u>i</u>tle, <u>i</u>dle
	13	i → [ay] /__CV	p<u>i</u>lot, c<u>i</u>der
	14	i → [ay] /__C$\{^{r}_{l}\}$V	m<u>i</u>grate, <u>i</u>dly
	15	i → [I] /__C(C)#	s<u>i</u>t, m<u>i</u>lk
	16	i → [I] /__CC....	h<u>i</u>dden, l<u>i</u>ttle
	17	i → [ə], [I] in unstressed syllables	miss<u>i</u>le, off<u>i</u>ce
	21	i → [ə] /__$\{^{rC}_{r\#}\}$	b<u>i</u>rd, s<u>i</u>r
	22	i → [ay] /__$\left\{\begin{matrix}nd\\ld\\gn\end{matrix}\right\}$#	f<u>i</u>nd, w<u>i</u>ld, s<u>i</u>gn
	24	i → [ay] /__gh This gh is always silent; igh can be considered a unit, pronounced [ay].	h<u>i</u>gh, r<u>i</u>ght
	25	i → [y] /C_VC	mill<u>i</u>on, on<u>i</u>on
	26	i → [ay] /_-V	l<u>i</u>-ar, d<u>i</u>-et
	32	i → Ø	aspirin
	38	i → [I] /_$\{^{vV}_{x(1)V}\}$	c<u>i</u>vic, r<u>i</u>ver
O	11	o → [o] /_Ce#	h<u>o</u>me, sm<u>o</u>ke
	12	o → [o] /_C$\{^{r}_{l}\}$e#	<u>o</u>rge, n<u>o</u>ble
	13	o → [o] /_CV	n<u>o</u>tice, <u>o</u>dor

Grapheme Unit	Rule #	Rule Description & Comment	Examples
O	14	o → [o] /_C{r, l}	okra, only
	15	o → [a] /_C(C)#	lot, lock
	16	o → [a] /_CC....	motto, hockey
	17	o → [ə], [I] in unstressed syllables	cotton, sailor
	21	o → [a], [o], [ɔ] /_r There is a great deal of dialect variation here.	horn, tortoise
	22	o → [ə] /w_RC	word, worth
	23	o → [o] /_lC#	roll, gold, yolk bolt
	24	o → [ɔ], [a] /_{fC, ng, ss, st, th, g#} There is a great deal of dialect variation here.	off, soften, song, moss, lost, moth, dog
	25	o → [o] /_#	go, motto
	26	o → [o] /_-V	po-em
	31	o → [ə] This occurs in stressed syllables where other pronunciations would be expected. 031 generally occurs before m, n, v, th.	won, mother some, love
	32	o → Ø	sophomore, licorice
	38	o → [a] /_{vV, x(1)V}	novel, oxen
U	11	u → [(y)u] /_Ce#	use, crude
	12	u → [(y)u] /_C{r, l}e#	bugle

Grapheme Unit	Rule #	Rule Description & Comment	Examples
U	13	u → [(y)u] /_CV	unit, crusade
	14	u → [(y)u] /_C$\{^{r}_{l}\}$V	bugler
	15	u → [ə] /_C(C)#	gum, fuss
	16	u → [ə] /_CC....	sudden, justice
	17	u → [ə], [I] in unstressed syllables	lettuce, minute
	20	u → Ø /#g__V	guest, guard
	26	u → [(y)u] /__-V	fluid, ruin
	31	u → [U] This occurs mainly after p, b and f, and before l(l) and sh.	bull, push, put
	32	u → Ø	natural
Y	11	y → [ay] /__C$\{^{r}_{l}\}$V This is the generalized long-vowel rule for y, combining Rules 11-14 because of low productivity. As with the other primary vowels, this rule may be divided into four rules; see pp. 16-17.	rhyme, cycle, cyclone
	15	y → [I] /__$\{^{CC}_{C\#}\}$ This is the generalized short-vowel rule for y, combining Rules 15 and 16 because of low productivity. As with the other primary vowels, this rule may be divided into two rules; see p. 17.	myth, gym
	17	y → [i], [I] /__# in unstressed syllables	baby, candy

Grapheme Unit	Rule #	Rule Description & Comment	Examples
Y	19	y → [ay] /__# in stressed syllables (including one-syllable words)	deny, try
		Also see the consonant correspondence rules for Rule Y10.	

C. Spelling-to-sound correspondence rules for secondary vowels

Grapheme Unit	Rule #	Rule Description & Comment	Examples
AI	10	ai → [e]	stain, rain
	17	ai → [ə], [I] in unstressed syllables	captain, villain
AY	10	ay → [e] In unstressed syllables, ay may be pronounced [i] (e.g., Sunday).	day, play
AU	10	au → [ɔ]	cause, author
AW	10	aw → [ɔ]	saw, hawk
EA	11	ea → [i] In the present classification, eal is considered one syllable pronounced [il] (e.g., real, ideal).	each, heat
	31	ea → [ɛ]	bread, deaf heaven
	33	ea → [ə] /__r	earn, search
		ea is sometimes a combination of e and a (e.g., create); cf. Rule E26.	
EE	10	ee → [i]	beet, feel
EI	10	ei → [i]	receive, ceiling
	20	ei → [e] /__{gn, n, gh}	reign, rein, neighbor

Grapheme Unit	Rule #	Rule Description & Comment	Examples
EW	10	ew → [(y)u]	few, new
EY	10	ey → [e]	they, obey
	17	ey → [i] in unstressed syllables	donkey, money
IE	11	ie → [ay] /__#	die, lie
	12	ie → [i] /__.... This rule applies medially.	field, grief
	17	ie → [i] /__# in unstressed syllables	collie, movie
	ie is sometimes a combination of i and e (e.g., science, diet); cf. Rule I26.		
OA	10	oa → [o]	load, boat
OE	10	oe → [o] /__#	hoe, toe
	Medial oe is a combination of o and e (e.g., poet); cf. Rule 026.		
OI	10	oi → [oy]	noise, join
OO	11	oo → [u]	broom, tool
	12	oo → [U]	book, wood
OU	10	ou → [aw]	count, mountain
	31	ou → [ə]	couple, young
	33	ou → [(y)u]	through, group
	34	ou → [ɔ]	fought, thought
	35	ou → [o]	soul, though
OW	11	ow → [o] In unstressed syllables OW11 may be pronounced [ə] (e.g., yellow).	glow, below, own, bow
	12	ow → [aw]	now, allow, owl, bow

Grapheme Unit	Rule #	Rule Description & Comment	Examples
OY	10	oy → [oy]	boy, toy
UE	10	ue → [(y)u] In the present classification, uel is considered one syllable pronounced [(y)ul] e.g., duel, cruel.	blue, argue
		ue is sometimes a combination of u and e (e.g., fluent); cf. Rule U26.	
UI	10	ui → [(y)u]	fruit, juice
	31	ui → [I]	build, biscuit
		ui is sometimes a combination of u and i (e.g., ruin, fluid); cf. Rule U26.	

III. Consonants

A. Introduction

Consonant rules are much more regular than vowel rules. Most consonants have only one correspondence (a Rule 10). A geminate consonant is generally pronounced the same as the corresponding single consonant; however, rules have been given for all geminate consonants. There is little other generalization possible among consonants, except for the similarity between Rules C11 and G11 and between Rules C12 and G12.

B. Spelling-to-sound correspondence rules for consonants

Grapheme Unit	Rule #	Rule Description & Comment	Examples
B	10	b → [b]	boy, cub, number
	20	b → Ø /m__#	climb, comb
BB	10	bb → [b]	bubble, blubber

Grapheme Unit	Rule #	Rule Description & Comment	Examples
C	11	c → [s] / __ {e, i, y} When sc occurs before e, i, or y, the c is pronounced--regularly--as [s], thus giving the pronunciation [s] for sc (e.g., scene, science).	city, lace, fancy
	12	c → [k] / __ {a, o, u, C, #}	cat, come, cut cream, picnic, scare
CC	12	cc → [k] / __ {a, o, u}	yucca, account, accuse
		When cc appears before e, i, or y, it is a combination of Rules C12 and C11, giving the pronunciation [ks] (e.g., success).	
CH	10	ch → [č] cf. Rule TCH 10	cheap, church
	31	ch → [k]	ache, school, chord, Christ
CK	10	ck → [k]	kick, pack
D	10	d → [d] This rule does not include past tense endings.	dead, needle
DD	10	dd → [d]	hidden, sudden
F	10	f → [f]	fat, after
FF	10	ff → [f]	off, taffy
G	11	g → [ǰ] / __ {e, i, y}	gem, age, gin, gypsy

Grapheme Unit	Rule #	Rule Description & Comment	Examples
G			
	12	g → [g] / $__\left\{\begin{matrix}a\\o\\u\\C\\\#\end{matrix}\right\}$	gave, go, gum, green, bag
	31	g → [g] This rule covers the number of exceptions (often very common) to Rule G11.	get, girl
GG	10	gg→ [g]	egg, wiggle
GH	10	gh→ Ø	though, taught, high
H	10	h → [h]	home, ahead
	20	h → Ø	rajah, hour
J	10	j → [ǰ]	joy, judge
K	10	k → [k]	milk, kill
	20	k → Ø /#__n	know, knot
L	10	l → [l]	like, mile
	20	l → Ø / $\left\{\begin{matrix}o__k\\a__f\\a__k\\a__m\\a__v\end{matrix}\right\}$	yolk, folk, half, calf, walk, stalk, palm, calm, calves, salve
LE	22	le→ [əl] /C__#	little, stable
LL	10	ll→ [l]	bullet, fill
M	10	m → [m]	man, came
MM	10	mm → [m]	summer, mammal
N	10	n →[n]	no, nine, fun

Grapheme Unit	Rule #	Rule Description & Comment	Examples
N	20	n → [ŋ] / __ { x; k; qu; g pronounced [g]; c pronounced [k] }	anxious, thank, sink, banquet, single, fungus, finger, Lincoln
		This pronunciation of n is an automatic phonological alternation; therefore, it probably should not be explicitly taught.	
NN	10	nn → [n]	inner, funny
NG	10	ng → [ŋ] / __# Cf. Rule N20.	ring, song
P	10	p → [p]	people, pop
PP	10	pp → [p]	pepper, apple
PH	10	ph → [f]	phone, photo
QU	10	qu → [kw]	quick, banquet
R	10	r → [r]	run, far
RR	10	rr → [r]	hurry, marriage
S	10	s → [s] This rule does not include inflectional endings: plurals (e.g., boys - cf. Rule S31), possessives (e.g., bov's) and third person singular verb forms (e.g., knows).	sun, fast, horse
	20	s → [z] / V__V	nose, easy
	21	s → [s] / { ou; oo; ea; a } __ e	house, moose, lease, case

Grapheme Unit	Rule #	Rule Description & Comment	Examples
S	31	s → [z] /__# This rule covers plural forms whether or not there is a singular (cf. Rule E19). It also covers words which are not plurals, but which have related forms without the final s (e.g., news, hers).	trousers, wives, riches
SS	10	ss → [s]	mess, missile
SH	10	sh [š]	shoe, rush
T	10	t → [t]	title, let
	20	t → Ø / {s__le# / s__en# / f__en}	wrestle, fasten, often
TT	10	tt → [t]	little, mitt
TCH	10	tch → [č] Cf. rule CH10	match, notch
TH	11	th → [ə]	thin, bath
	12	th → [ð] / __{e / er / erm}#	bathe, father, northern
	13	th → [ð] in pronouns, conjunctions, and function words.	they, although the
V	10	v → [v]	vase, love
W	10	w → [w]	wet, beware
	20	w → Ø /#__r	wren, wrong

w is sometimes the second part of a secondary vowel combination (e.g., ew). When there is the possibility of confusion (when there is a vowel on each side of the w), syllable division is indicated.

Grapheme Unit	Rule #	Rule Description & Comment	Examples
WH	10	wh → [hw] or [w] (depending on dialect)	when, whether
X	10	x → [ks]	box, oxen
Y	10	y → [y]	yet, beyond
		y is sometimes the second part of a secondary vowel combination (e.g., oy). When there is the possibility of confusion (when there is a vowel on each side of the y), syllable division is indicated. y is also a primary vowel.	
Z	10	z → [z]	zoo, lazy
ZZ	10	zz → [z]	buzz, fuzzy

Key to Pronunciation

The following phonetic symbols are used to indicate the pronunciation of the grapheme units. The symbols used in Webster's New World Dictionary are given on the right for reference.

Symbol	Key words (corresponding graphemes underlined)	Dictionary Symbol
Vowels		
[i]	sc<u>e</u>ne, n<u>ea</u>t, s<u>ee</u>, ch<u>ief</u>	ē
[I]	b<u>i</u>t	i
[e]	n<u>a</u>me, s<u>ay</u>, th<u>ey</u>	ā
[ɛ]	g<u>e</u>t, h<u>ea</u>d	e
[æ]	f<u>a</u>t, b<u>a</u>d	a
[a]	h<u>o</u>t, c<u>ar</u>	o
[ɔ]	s<u>o</u>ng, l<u>o</u>ss, t<u>augh</u>t, l<u>aw</u>n, t<u>a</u>lk, b<u>a</u>ll, th<u>ough</u>t	ô
[o]	b<u>o</u>ne, g<u>o</u>, f<u>o</u>rk, t<u>oe</u>, b<u>oa</u>rd, kn<u>ow</u>	ō
[U]	p<u>u</u>t, p<u>u</u>sh, b<u>oo</u>k, c<u>ou</u>ld	oo
[u]	f<u>oo</u>d, d<u>ew</u>, t<u>u</u>ne	o͞o
[ə]	b<u>u</u>t, <u>a</u>b<u>o</u>ve	ə (unstressed) u (stressed)
[ay]	cr<u>y</u>, m<u>i</u>ne, d<u>ie</u>	ī
[aw]	f<u>ou</u>nd, <u>ow</u>l	ou
[oy]	b<u>oy</u>, n<u>oi</u>se	oi
Consonants		
[b]	<u>b</u>oy, ca<u>b</u>	b
[č]	<u>ch</u>ur<u>ch</u>, <u>ch</u>ip, hat<u>ch</u>	ch
[d]	<u>d</u>ead, <u>d</u>o	d
[f]	<u>f</u>un, <u>f</u>air, o<u>ff</u>	f

Symbol	Key words (corresponding graphemes underlined)	Dictionary Symbol
[g]	go, gay, egg	g
[h]	home, head	h
[ǰ]	judge, gem, age	j
[k]	kill, kick, come, cat	k
[l]	let, hill	l
[m]	man, ham	m
[n]	no, hand	n
[ŋ]	sing, single, think	ŋ
[p]	pull, trip	p
[r]	red, far	r
[s]	see, ice, miss	s
[š]	she, sure, issue, nation, hash	sh
[t]	ten, hit, liked	t
[v]	vase, love	v
[w]	wet, language, quick	w
[y]	yet, you	y
[z]	zoo, lazy, please, wives	z
[ž]	vision, treasure	zh
[θ]	thing, bath	th
[ð]	them, bathe	th

Note the following pronunciations:

[kw] as in quick, queen

[ks] as in ax, extra

[gz] as in exist

[hw] as in (in some dialects) <u>wh</u>en, <u>wh</u>ich

[yu] as in f<u>u</u>se, f<u>ew</u> (dictionary symbol: $\bar{u}$)

[ər] as in doll<u>ar</u>, fath<u>er</u>, s<u>ir</u>, col<u>or</u>, b<u>urn</u>

TABLE A SUMMARY OF PRIMARY VOWEL RULES 11-17

Rule		Grapheme, Pronunciation and Examples				
		A	E	I	O	U
11.	V → [V̄] /__Ce#	[e]: name brave	[i]: scene here	[ay]: fine like	[o]: home smoke	[(y)u]: use crude
12.	V → [V̄] /__C{r l}e#	[e]: acre stable	[i]: **	[ay]: title idle	[o]: orge noble	[(y)u]: bugle*
13.	V → [V̄] /__CV	[e]: baby native	[i]: hero meter	[ay]: pilot cider	[o]: notice odor	[(y)u]: unit crusade
14.	V → [V̄] /__C{r l}V	[e]: April fragrant	[i]: zebra declare	[ay]: migrate idly	[o]: okra only	[(y)u]: bugler*
15.	V → [V̆] /__C(C)#	[æ]: sat fast	[ɛ]: set felt	[ɪ]: sit milk	[a]: hot lock	[ə]: gum fuss
16.	V → [V̆]/__CC...	[æ]: saddle jacket	[ɛ]: edge extra	[ɪ]: hidden little	[a]: motto hockey	[ə]: sudden justice
17.	V → [ə], [ɪ] in unstressed syllables	[ə], [ɪ]: above final	[ə], [ɪ]: hidden talent	[ə], [ɪ]: missile office	[ə], [ɪ]: cotton sailor	[ə], [ɪ]: lettuce minute

** no examples in our vocabulary.

* only example in our vocabulary.

TABLE B SUMMARY OF VOWEL RULES 26, 32, and 38

Rule	Grapheme, Pronunciation and Examples				
	A	E	I	O	U
26. V → [V̄] /__-V	[e]: ** (cha-os)	[i]: cre-ate me-ow	[ay]: li-ar di-et	[o]: po-em po-et	[(y)u]: flu-id ru-in
32. V → Ø	Ø: separate (AJ) diamond	Ø: several difference	Ø: aspirin*	Ø: sophomore licorice	Ø: natural*
This vowel can also be pronounced [ə], adding another syllable.					
38. V → [V̆] /__{vV, x(1)V}	[æ]: cavern axis axle	[ɛ]: clever exit	[ɪ]: civic river	[a]: novel oxen	[ə]: ** (buxom)

** no examples in our vocabulary; parenthesized examples not in our vocabulary.

* only example in our vocabulary.

APPENDIX II
ALTERNATE RULE SEQUENCES

(1) Fry (1964)

1. Easy consonants: T10, N10, R10, M10, D10, S10, L10, C12, P10, F10
2. Short Vowels: A15, E15, 115, 015, U15
3. Silent, word final E: E18
4. Y rule: AY10, EY10
5. Infrequent consonants: V10, G12, H10, W10, K10, J10, Z10, Y10, X10, QU10
6. Consonant digraphs: CH10, SH10, TH11, TH12, TH13, WH10, NG10, PH10, GH10
7. Second consonant sounds: C11, S20, G11
8. Final E rule: E18, A11, E11, I11, 011, U11
9. Long vowel digraphs: AI10, AY10, EA11, EE10, OW11, OA10, UE10
10. Syllable ending rule: A13, E13, I13, 013, U13
11. Schwa: A17, C17, E17
12. Vowel plus r rule: E21, 121, A21, 021
13. Broad O rule: AU10, AW10, A23, 024
14. Diphthongs: OI10, OY10, OU10, OW12
15. Double O rule: OO11, OO12
16. Initial consonants blends: [not included in SWRL Word Attack Activity rules of correspondence]
17. Final consonant blends: [also not included in the correspondence rules]
18. Second sound of EA: EA31
19. Doubled consonants: LL10, RR10, PP10, TT10
20. Silent consonants: K20, W20, CK10

APPENDIX II (continued)

(2) Black (1961)

Vowels - major rules

1. Teach short sounds of vowels first.

   A15, E15, I15, O15, U15

2. Double vowel rule: when two vowels are together, the first is long and the second is silent. This over-simplification has many exceptions such as diphthongs. Therefore some teachers prefer to teach the seven common occurrences of double vowels.

   AI10, AY10, EA11, EE10, OW10, OA10, UE10

3. Final E rule: E at the end of a word makes the preceding vowel long.

   A11, E11, I11, O11, U11, E18 (final E)

   Irrespective of this rule, E at the end of a word is nearly always silent.

4. Syllable ending rule: if the syllable is open (ends in a vowel), the vowel is long.

   A13, E13, I13, O13, U13

   [The word used as an example of E13 (he) actually utilized the E25 rule in the present notation.]

5. Schwa rule: A, E, and O sometimes make a sound similar to the short U sound when there is another accented vowel in the word.

   A17, O17, E17

6. Vowel plus R rule: R after a vowel makes a new sound; ER, UR, and IR all make the same sound.

   E21, U15 & U16, I21

   [A U21 rule was eliminated from the present rules in order to reduce the number of rules. U15 and U16 both go to [ə] as U21 does; therefore, this attempt at economy was made. The decision

APPENDIX II (continued)

to eliminate Rule U21 will probably be reversed in the first revision cycle.]

A21, O21

7. The Y rule: Y at the end of a long word (another vowel present) has the sound of long E.

Y17

Y at the end of a short word or in the middle of a word has the sound of long I.

Y11

Y at the beginning of a word has the consonant sound.

Y10

Vowels - minor rules

8. OW, OU rule: OW and OU both have the diphthong sound as in out and owl.

OU10, OW12

9. Double O rule: Two O's sometimes have the (long) sound of OO.

OO11

Two O's sometimes have the (short) sound of OO.

OO12

10. Broad O rules: broad O sound is made by AU, AW, A followed by L and O in some words.

AU10, AW10, A23, O24

11. OI, OY rule: OI and OY both have the same sound.

OI10, OY10

12. Vowel exception: there is only one exception to the foregoing rules with a high enough frequency to be worth teaching beginning readers. EA sometimes has the short E sound

EA31

APPENDIX II (continued)

Consonants - major rules

1. Single consonants are quite consistent in making the same sound. They should be taught in the following order:

   T10, N10, R10, M10, D10
   S10, L10, C12, P10, B10
   F10, V10, G11, H10, W10
   K10, J10, Z10, Y10

   [Rank order of consonants is based only on occurrence frequency.]

2. Second sounds of consonants have a surprisingly high frequency and should not be neglected.

   C11, S20, G11

3. Consonant digraphs must be taught as digraphs because they make a unique sound as does a single consonant; they are not blends.

   CH10, TH12, SH10, TH11, WH10

4. Difficult consonants do not have any sound of their own but instead make the sound of the blend of two other consonants.

   X10, QU10

Consonants - minor rule

5. Initial consonant blends: [Consonant clusters are not within the domain of our rules; therefore, their treatment is omitted here.]

Consonants - very minor rules

6. Final consonant blends: from the standpoint of necessity these blends are not as worthwhile as initial sounds but some teachers find them worthwhile.

   NG10

   [Several other final consonant blends are presented, but only the NG10 rule is represented by the current set of rules, and even it is not a blend, but a single consonant sound.]

APPENDIX II (continued)

7. Double consonants usually make the sound of a single consonant. Some common examples are as follows:

   LL10, RR10, PP10, TT10

8. PH always sounds like F.

   PH10

9. Silent consonants are rather uncommon. The only ones worth mentioning are as follows:

   CK10, K20, W20

   [CK10 does not conform to the concept of silent consonant as do K20 and W20; it does not belong in the silent consonant class any more than do geminate consonant clusters.]

(3) Heilman (1964)

1. Consonant rules are taught first. The following rationale is given for this decision:

   1. The majority of words children meet in beginning reading start with consonants.

   2. It is desirable that children learning to read look at the beginning of a word first; and if phonic analysis is necessary, it should begin with the first part of the word.

   3. The consonant sounds are much more constant than vowel sounds. When children learn the sound of a given consonant, this sound will "hold" in most words the child meets (p.26).

a. The first consonant rules to be introduced are: B10, M10, R10, P10, L10, H10, K10, V10, J10, N10 and F10.

b. The consonant digraphs SH10, WH10, TH10 and CH10 appear next.

c. [Consonant blends (clusters), which are not within the domain of the SWRL Word Activity rules of correspondence, follow the consonant digraphs.]

APPENDIX II (continued)

d. The second group of consonant digraphs, NG10, QU10, CK10, as well as N20 appear next.

e. Heilman subdivides consonant irregularities as follows:

1. Consonants which have more than one sound (C11, C12, G11, G12, S10, S20).

2. Consonants which are not sounded (K20, GH10, W20, B20, T20, L20, H20).

3. Consonant combinations with unique pronunciations (PH10).

2. Vowel rules

a. The short vowel sounds are introduced here, with the following rationale offered by Heilman:

1. A majority of the words a child meets in beginning reading contain short vowel sounds.

2. Many of these words are sing e-vowel in medial-position words. The phonic generalization covering this situation is one that holds or applies in a large percentage of words met in beginning reading: One vowel in the middle of a word (or syllable) usually has its short sound.

The first vowel rules taught are A15, E15, I15, O15 and U15.

b. The secondary vowels OA10, AI10, EA11 and EE10.

c. Long vowel sounds E18, A11, E11, I11, O11 and U11.

d. Final vowel digraphs with Y: AY10, EY10.

e. One-syllable, one vowel words, E25, O25 and Y19.

f. Exceptions: (1) O23, I22
(2) "vowel-r" rules: A21, E21, I21 and O21
(3) A23

g. The double O rules: OO11 and OO12

h. Diphthongs: OU10, OW12, OI10 and OY10.

APPENDIX II (continued)

(4) Bloomfield (1942a, 1942b; Bloomfield & Barnhart, 1961)

[Where Bloomfield's rules do not overlap SWRL notation they are phonetically described. In such cases Bloomfield's examples accompanying the rules are included.]

I. A15 E15 I15 O15 U15

B10 C12 D10 F10 G10 H10 J10 K10 L10 M10
N10 P10 R10 S10 T10 V10 W10 Y10 Z10

II. (a) NG10 N20 SH10 CH10 TH11 WH10 CK10 TCH10
(b) LL10 GG10
(c) QU10 X10

[The initial group in Block II, deleted here, consists of consonant clusters composed of the consonants in Block I.]

III. EE10 EA11 OO11 AI10 AY10 OA10 OU10 OW12 AW10 AU10
OY10 OI10

IV. TH12 S20 E25

V. A11 A21 A23 A24 O24 O25 OW11 O21 I11 Y17
O31 OU31 OU35 U31 OO12 I21 U11 EW10 EA31 E11

Rules not included in the Word Attack Activity:

Grapheme Unit	Rule Description	Example
EA	EA → [e]	st<u>eak</u>
OO	OO → [o]	d<u>oor</u>

[Bloomfield refers to the representation of any vowel, other than a Rule 15, as semi-irregular.]

VI. C11 G11 K20 W20 B20 L20 H20 T20 N20 GH10
PH10 OU31 Y15 IE12 EI10 EY17 EI20 EY10 I25

[At this point all of the following rules are considered irregular.]

Rules not included in the Word Attack Activity.

APPENDIX II (continued)

Grapheme Unit	Rule Description	Example
DG	DG → [ǰ]	badge
G	G → [Ø]	gnaw
GH	GH → [f]	rough
O	O → [U]	woman
OU	OU → [U]	could
O	O → [u]	do
OE	OE → [u]	shoe
EAU	EAU → [(y)u]	beautiful
IEW	IEW → [(y)u]	view
U	U → [I]	busy
E	E → [I]	pretty
IE	IE → [I]	sieve
EO	EO → [i]	people
EY	EY → [i]	key
I	I → [i]	gasoline
A	A → [ɛ]	any
AI	AI → [ɛ]	again
UE	UE → [ɛ]	guess
U	U → [ɛ]	bury
IE	IE → [ɛ]	friend
EW	EW → [o]	sew
OA	O → [ɔ]	broad

APPENDIX II (continued)

Grapheme Unit	Rule Description	Example
UY	UY → [ay]	buy
UI	UI → [ay]	guide
EA	EA → [a]	heart
UA	UA → [a]	guard
U	U → [w]	language
S	S → [š]	sure
CE	CE → [š]	ocean
CH	CH → [š]	machine
G	G → [ž]	rouge
X	X → [gz]	exact

(5) Stanford Project (Hansen & Rodgers, 1965; Rodgers, 1967)

LEVEL I	A15, B10, C12, D10, F10, G12, H10, M10, N10, P10, R10, S10, T10
LEVEL II	I15, L10, W10
LEVEL III	E18, E15, A11
LEVEL III'	A21, I21, CK10, LL10, SS10, I15, X10, V10, K10
LEVEL IV	O11, I15, Y17, E25
LEVEL IV'	I11, J10, OI10, AI10, OO12, GH10, AY10, I24
LEVEL V	U15, E11, U11, O25
LEVEL V'	O21, E21, NG10, L20, EE10, EA11, OU10, OW12, OA10, OW11, AU10, AW10, EW10, OY10
LEVEL VI	IE11, EI10, Y10, Z10, QU10

APPENDIX II (continued)

[The above rules are taught at nine levels which correspond to blocks in the SWRL Word Attack Activity sequence.]

(6) SWRL First and Second Year Communication Skill Programs

First Year

Unit	I	M10, S10, T10, A15, EE10
	II	N10, I15
	III	NN10, TH13
	IV	D10
	V	F10, LL10, SS10, W10, E15
	VI	R10, U15
	VII	L10, SH10
	VIII	H10
	IX	----
	X	B10

Second Year

Week	1	----
	2	C12
	3	DD10, P10
	4	G12, GG10
	5	J10, K10
	6	Y10, Z10
	7	----
	8	FF10, A16

APPENDIX II (continued)

9	Y17
10	MM10, TT10, O15, O16
11	----
12	E16
13	----
14	ZZ10, U16
15	I16
16	----
17	Y19
18	V10, X10
19	OW12
20	A11, E18
21	I11
22	----
23	O11, U11
24	QU10
25	CH10
26	N20, NG10
27	A21
28	E21, I21
29	O21
30	C11
31	G11

APPENDIX II (continued)

TABLE 1: Words per rule in the SWRL First- and Second-Year Communication Skills Programs

PRIMARY VOWELS

RULE	1	2	T	RULE	1	2	T	RULE	1	2	T
*A11	0	20	20	25	4	1	5	*U11	0	4	4
13	0	3	3	*I11	0	20	20	* 15	9	12	21
* 15	28	19	47	* 15	23	37	60	*U16	0	8	8
* 16	0	10	10	* 16	0	9	9	31	0	2	2
17	0	6	6	17	0	1	1	40	0	1	1
* 21	0	14	14	* 21	0	7	7	*Y17	0	24	24
23	0	1	1	38	0	2	2	* 19	0	8	8
24	0	1	1	40	1	3	4	SECONDARY VOWELS			
29	0	1	1	*O11	0	6	6	AI10	0	2	2
38	0	1	1	13	0	2	2	AI40	0	1	1
40	3	6	9	* 15	2	14	16	AY10	0	6	6
E11	0	1	1	* 16	0	6	6	EA11	0	2	2
13	0	2	2	17	0	3	3	*EE10	9	4	13
14	0	1	1	* 21	0	6	6	EY10	0	1	1
* 15	19	28	47	23	0	1	1	40	0	1	1
* 16	0	8	8	24	0	12	12	OE40	0	1	1
17	0	6	6	25	1	3	4	OO11	0	1	1
* 18	0	54	54	31	0	3	3	12	0	1	1
* 21	0	14	14	40	1	5	6	OU10	0	2	2

* taught as rules

APPENDIX II (continued)

Table 1 (continued)

RULE	1	2	T
33	0	2	2
OW11	0	1	1
* 12	0	4	4
E32	0	1	1
38	0	1	1
40	1	5	6
UE10	0	1	1
CONSONANTS			
*B10	9	24	33
*C11	0	7	7
* 12	0	17	17
*CH10	0	9	9
CK10	0	6	6
*D10	16	48	64
*DD10	0	1	1
*F10	10	17	27
40	0	1	1
*FF10	0	1	1
*G11	0	2	2
* 12	0	21	21
31	0	4	4

RULE	1	2	T
*GG10	0	2	2
*H10	10	15	25
*J10	0	9	9
*K10	0	22	22
*L10	2	36	38
*LL10	10	11	21
LE22	0	5	5
*M10	14	39	53
*MM10	0	1	1
*N10	24	52	76
*N20	0	4	4
*NN10	1	1	2
*NG10	0	16	16
*P10	0	34	34
PP10	0	3	3
*QU10	0	3	3
*R10	3	78	81
RR10	0	1	1
*S10	16	47	63
20	0	3	3
40	4	3	7

RULE	1	2	T
*SS10	1	4	5
*SH10	6	2	8
*T10	30	76	106
40	0	1	1
*TT10	0	3	3
TH11	2	7	9
12	0	1	1
* 13	5	2	7
*V10	0	16	16
*W10	9	9	18
WH10	1	5	6
40	1	0	1
*X10	0	9	9
*Y10	1	8	9
*Z10	0	5	5
*ZZ10	0	1	1

APPENDIX III
RULE FREQUENCY DATA

Table 1 Rule word frequencies and occurrence frequencies[11]

Table 2 A rank listing of rule word frequencies and occurrence frequencies[12]

Table 3a Rank-ordered rule word frequencies: Breakdown by age and syllabification[13]

3b Rank-ordered Rule 40 frequencies: Breakdown by age and syllabification

Table 4 Rule pair-per-word frequencies and conditional frequencies

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[11]Table 1 also appears in rules vocabulary project report (Berdiansky, Cronnell & Koehler, 1969) under same title (Table 1, pp. 71-75).

[12]Table 2 also appears in Berdiansky, Cronnell & Koehler (Table 2, pp. 76-80).

[13]Tables 3a and 3b also appear in Berdiansky, Cronnell & Koehler (Table 3, pp. 81-87).

TABLE 1 RULE WORD FREQUENCIES AND OCCURRENCE FREQUENCIES

83 Consonant Rules *

B (2-694-4-698-0.6%)**

B10	680	(713)
B20	14	(14)
B4C	4	(4)

BB (1-30-0-30-0.02%)

BB10	30	(30)

C (2-902-4-906-0.4%)

C11	212	(213)
C12	690	(720)
C40	4	(4)

CC (1-9-0-9-0.0%)

CC12	9	(9)

CH (2-198-12-210-5.7%)

CH10	172	(173)
CH31	26	(26)
CH40	12	(12)

CK (1-187-0-187-0.0%)

CK10	187	(188)

D (1-1010-12-1022-1.2%)

D10	1010	(1060)
D40	12	(12)

DD (1-44-0-44-0.0%)

DD10	44	(44)

F (1-524-1-525-0.2%)

F10	524	(534)
F40	1	(1)

FF (1-51-0-51-0.0%)

FF10	51	(51)

G (3-537-15-552-2.7%)

G11	154	(155)
G12	361	(364)
G31	22	(22)
G40	15	(15)

GG (1-27-0-27-0.0%)

GG10	27	(27)

GH (1-86-11-97-11.3%)

GH10	86	(86)
GH40	11	(11)

H (2-313-18-331-5.4%)

H10	302	(302)
H20	11	(11)
H40	18	(18)

J (1-80-0-80-0.0%)

J10	80	(80)

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*83 Rules applies to 44 Consonant graphemes: 60 Regular Rules and 23 Exceptions (Rule 40s).

**For the graphemes class B, there are two regular rules. B's two regular rules occur in 694 words, and exceptions to these two rules (marked B40) occur in four words, for a total B word frequency of 698. The percentage of exception word frequency to the total word frequency of the grapheme = 0.6%. In most instances, the percentage of a rule's exception word frequency to total word frequency is small even when the exception frequency appears large. In the few classes in which the percentage is greater than 10, the exception frequency is small, but so is the total frequency. For each individual rule, the occurrence frequency is given in parentheses. This number is often greater than the word frequency because in some words the correspondence (rule) occurs more than once.

(Table 1, continued)

K (2-369-0-369-0.0%)

K10 343 (354)
K20 26 (26)

L (2-1412-6-1418-0.4%)

L10 1391 (1428)
L20 21 (21)

L40 6 (6)

LE (1-171-0-171-0.0%)

LE22 171 (171)

LL (1-186-0-186-0.0%)

LL10 186 (186)

M (1-830-0-830-0.0%)

M10 830 (852)

MM (1-24-0-24-0.0%)

MM10 24 (24)

N (2-1549-18-1567-1.1%)

N10 1441 (1528)
N20 108 (108)

N40 18 (18)

NN (1-41-0-41-0.0%)

NN10 41 (41)

NG (1-146-5-151-3.3%)

NG10 146 (148)

NG40 5 (5)

P (1-995-6-961-0.6%)

P10 955 (993)

P40 6 (6)

PP (1-41-0-41-0.0%)

PP10 41 (41)

PH (1-31-0-31-0.0%)

PH10 31 (32)

QU (1-62-11-73-15.1%)

QU10 62 (62)

QU40 11 (11)

R (1-2345-2-2347-0.1%)

R10 2345 (2512)

R40 2 (2)

RR (1-65-0-65-0.0%)

RR10 65 (65)

S (4-1510-62-1572-3.9%)

S10 1294 (1322)
S20 122 (123)
S21 31 (31)
S31 63 (63)

S40 62 (62)

SS (1-158-6-164-3.7%)

SS10 158 (158)

SS40 6 (6)

SH (1-219-0-219-0.0%)

SH10 219 (219)

T (2-1690-15-1705-0.9%)

T10 1670 (1803)
T20 20 (20)

T40 15 (15)

TT (1-93-0-93-0.0%)

TT10 93 (93)

TCH (1-40-0-40-0.0%)

TCH10 40 (40)

TH (3-206-12-218-5.5%)

TH11 159 (161)
TH12 25 (25)
TH13 22 (22)

TH40 12 (12)

V (1-306-0-306-0.0%)

V10 306 (309)

W (2-323-3-326-0.9%)

W10 302 (304)
W20 21 (21)

W40 3 (3)

WH (1-38-7-45-15.6%)

WH10 38 (38)

WH40 7 (7)

X (1-74-7-81-8.6%)

X10 74 (74)
X40 7 (7)

Y (1-48-0-45-0.0%)

Y10 48 (49)

Z (1-54-1-55-1.8%)

Z10 54 (55)
Z40 1 (1)

ZZ (1-14-1-15-6.7%)

ZZ10 14 (14)
ZZ40 1 (1)

(Table 1, continued)

79 Primary Vowel Rules*

A (15-1774-128-1902-6.7%)

A11	250	(250)
A12	12	(12)
A13	77	(77)
A14	5	(5)
A15	331	(331)
A16	376	(376)
A17	405	(405)
A21	163	(163)
A22	23	(23)
A23	37	(37)
A24	29	(29)
A25	30	(30)
A29	19	(19)
A32	3	(3)
A38	14	(14)
A40	128	(128)

E (13-2814-88-2916-3.0%)

E11	30	(30)
E13	168	(168)
E14	18	(18)
E15	300	(300)
E16	272	(274)
E17	347	(347)
E18	1136	(1146)
E19	35	(35)
E21	451	(452)
E25	8	(8)
E26	2	(2)
E32	30	(30)
E38	17	(17)
E40	88	(88)

I (14-1389-79-1468-5.4%)

I11	209	(211)
I12	7	(7)
I13	63	(63)
I14	6	(6)
I15	502	(502)
I16	397	(397)
I17	45	(45)
I21	38	(38)
I22	26	(27)
I24	45	(45)
I25	17	(17)
I26	17	(17)
I32	1	(1)
I38	16	(16)
I40	79	(79)

O (16-1139-107-1246-8.6%)

O11	146	(146)
O12	2	(2)
O13	91	(91)
O14	4	(4)
O15	113	(114)
O16	173	(174)
O17	212	(212)
O21	160	(160)
O22	16	(16)
O23	38	(38)
O24	72	(73)
O25	36	(36)
O26	2	(2)
O31	62	(62)
O32	6	(6)
O38	6	(6)
O40	107	(107)

U (11-783-29-812-3.6%)

U11	66	(66)
U12	1	(1)
U13	41	(41)
U14	2	(2)
U15	282	(283)
U16	313	(315)
U17	4	(4)
U20	8	(8)
U26	9	(9)
U31	56	(56)
U32	1	(1)
U40	29	(30)

Y (4-480-15-495-3.0%)

Y11	14	(14)
Y15	14	(14)
Y17	421	(421)
Y19	31	(32)
Y40	15	(16)

*79 Rules apply to 6 Primary Vowel graphemes: 73 Regular Rules and 6 Exceptions (Rule 40s).

(Table 1, continued)

49 Secondary Vowel Rules*

AI (2-152-6-158-3.8%)

AI10	143	(144)
AI17	9	(9)
AI40	6	(6)

AU (1-37-8-45-17.8%)

AU10	37	(37)
AU40	8	(8)

AW (1-42-0-42-0.0%)

AW10	42	(42)

AY (1-71-1-72-1.4%)

AY10	71	(71)
AY40	1	(1)

EA (3-290-18-308-5.8%)

EA11	214	(214)
EA31	61	(61)
EA33	15	(15)
EA40	18	(18)

EE (1-176-2-178-1.1%)

EE10	176	(177)
EE40	2	(2)

EI (2-31-10-41-24.4%)

EI10	16	(16)
EI20	15	(15)
EI40	10	(10)

EW (1-38-2-40-5.0%)

EW10	38	(38)
EW40	2	(2)

EY (2-27-9-36-25.0%)

EY10	7	(7)
EY17	20	(20)
EY40	9	(9)

IE (3-62-6-68-8.8%)

IE11	9	(9)
IE12	38	(38)
IE17	15	(15)
IE40	6	(6)

OA (1-70-5-75-6.7%)

OA10	70	(70)
OA40	5	(5)

OE (1-8-5-13-38.5%)

OE10	8	(8)
OE40	5	(5)

OI (1-36-4-40-10.0%)

OI10	36	(36)
OI40	4	(4)

OO (2-167-12-179-6.7%)

OO11	118	(118)
OO12	49	(49)
OO40	12	(12)

OU (5-209-4-213-1.9%)

OU10	121	(121)
OU31	34	(34)
OU33	18	(18)
OU34	11	(11)
OU35	25	(25)
OU40	4	(4)

OW (2-124-0-124-0.0%)

OW11	69	(69)
OW12	56	(56)

*49 Rules apply to 19 Secondary Vowel graphemes: 33 Regular Rules and 16 Exceptions (Rule 40s).

(Table 1, continued)

OY (1-22-1-23-4.3%)

OY10	22	(22)
OY40	1	(1)

UE (1-26-6-32-18.6%)

UE10	26	(26)
UE40	6	(6)

UI (2-17-0-17-0.0%)

UI10	10	(10)
UI31	7	(7)

SUMMARIZED TABLE DATA

For the Combined Classes, there are 211 rules applied to 69 graphemes: 166 Regular Rules and 45 Exceptions (Rule 40s).

Consonants (60-17,692-239-17,931-1.3%)

Primary Vowels (73-8,379-446-8,825-5.1%)

Secondary Vowels (33-1605-99-1704-5.8%)

Combined Classes (166-27,676-784-28,460-2.8%)

TABLE 2: A RANK LISTING OF RULE WORD FREQUENCIES AND OCCURRENCE FREQUENCIES

211 Rules (Combined Classes)

	W.F.*	O.F.**		W.F.	O.F.		W.F.	O.F.		W.F.	O.F.
R10	2345	(2512)	LE22	171	(171)	FF10	51	(51)	G31	22	(22)
T10	1670	(1803)	E13	168	(168)	OO12	49	(49)	OY10	22	(22)
N10	1441	(1528)	A21	163	(163)	Y10	48	(49)	TH13	22	(22)
L10	1391	(1428)	O21	160	(160)	I17	45	(45)	L20	21	(21)
S10	1294	(1322)	TH11	159	(161)	I24	45	(45)	W20	21	(21)
E18	1136	(1146)	SS10	158	(158)	DD10	44	(44)	EY17	20	(21)
D10	1010	(1060)	G11	154	(155)	AW10	42	(42)	T20	20	(20)
P10	955	(993)	NG10	146	(148)	NN10	41	(41)	A29	19	(19)
M10	830	(852)	O11	146	(146)	PP10	41	(41)	E14	18	(18)
C12	690	(720)	AI10	143	(144)	U13	41	(41)	EA40	18	(18)
B10	680	(713)	A40	128	(128)	TCH10	40	(40)	H40	18	(18)
F10	524	(534)	S20	122	(123)	EW10	38	(38)	N40	18	(18)
I15	502	(502)	OU10	121	(121)	I21	38	(38)	OU33	18	(18)
E21	451	(452)	OO11	118	(118)	IE12	38	(38)	E38	17	(17)
Y17	421	(421)	O15	113	(114)	O23	38	(38)	I25	17	(17)
A17	405	(405)	N20	108	(108)	WH10	38	(38)	I26	17	(17)
I16	397	(397)	O40	107	(107)	A23	37	(37)	EI10	16	(16)
A16	376	(376)	TT10	93	(93)	AU10	37	(37)	I38	16	(16)
G12	361	(364)	O13	91	(91)	O25	36	(35)	O22	16	(16)
E17	347	(347)	E40	88	(88)	OI10	36	(36)	EA33	15	(15)
K10	343	(354)	GH10	86	(86)	E19	35	(35)	EI20	15	(15)
A15	331	(331)	J10	80	(80)	OU31	34	(34)	G40	15	(15)
U16	313	(315)	I40	79	(79)	PH10	31	(32)	IE17	15	(15)
V10	306	(309)	A13	77	(77)	S21	31	(31)	T40	15	(15)
H10	302	(302)	X10	74	(74)	Y19	31	(32)	Y40	15	(16)
W10	302	(304)	O24	72	(73)	A25	30	(30)	A38	14	(14)
E15	300	(300)	AY10	71	(71)	BB10	30	(30)	B20	14	(14)
U15	282	(283)	OA10	70	(70)	E11	30	(30)	Y11	14	(14)
E16	272	(274)	OW11	69	(69)	E32	30	(30)	Y15	14	(14)
A11	250	(250)	U11	66	(66)	A24	29	(29)	ZZ10	14	(14)
SH10	219	(219)	RR10	65	(65)	U40	29	(30)	A12	12	(12)
EA11	214	(214)	I13	63	(63)	GG10	27	(27)	CH40	12	(12)
C11	212	(213)	S31	63	(63)	CH31	26	(27)	D40	12	(12)
O17	212	(212)	O31	62	(62)	I22	26	(26)	OO40	12	(12)
I11	209	(211)	QU10	62	(62)	K20	26	(26)	TH40	12	(12)
CK10	187	(188)	S40	62	(62)	UE10	26	(26)	GH40	11	(11)
LL10	186	(186)	EA31	61	(61)	OU35	25	(25)	H20	11	(11)
EE10	176	(177)	U31	56	(56)	TH12	25	(25)	OU34	11	(11)
O16	173	(174)	OW12	55	(56)	MM10	24	(24)	QU40	11	(11)
CH10	172	(173)	Z10	54	(55)	A22	23	(23)	EI40	10	(10)

*W.F. = Word Frequency
O.F. = Occurrence Frequency

(Table 2, continued)

	W.F.	O.F.
UI10	10	(10)
AI17	9	(9)
CC12	9	(9)
EY40	9	(9)
IE11	9	(9)
U26	9	(9)
AU40	8	(8)
E25	8	(8)
OE10	8	(8)
U20	8	(8)
EY10	7	(7)
I12	7	(7)
UI31	7	(7)
WH40	7	(7)
X40	7	(7)
AI40	6	(6)
I14	6	(6)
IE40	6	(6)
L40	6	(6)
O32	6	(6)
O38	6	(6)
P40	6	(6)
SS40	6	(6)
UE40	6	(6)
A14	5	(5)
NG40	5	(5)
OA40	5	(5)
OE40	5	(5)
B40	4	(4)
C40	4	(4)
O14	4	(4)
OI40	4	(4)
OU40	4	(4)
U17	4	(4)
A32	3	(3)
W40	3	(3)
E26	2	(2)
EE40	2	(2)
EW40	2	(2)
O12	2	(2)
O26	2	(2)
R40	2	(2)
U14	2	(2)
AY40	1	(1)
F40	1	(1)
I32	1	(1)
OY40	1	(1)
U12	1	(1)
U32	1	(1)
Z40	1	(1)
ZZ40	1	(1)

(Table 2, continued)

60 Consonant Rules

R10	2345	(2512)	GG10	27	(27)
T10	1670	(1803)	CH31	26	(26)
N10	1441	(1528)	K20	26	(26)
L10	1391	(1428)	TH12	25	(25)
S10	1294	(1322)	MM12	24	(24)
D10	1010	(1060)	G31	22	(22)
P10	955	(993)	TH13	22	(22)
N10	830	(852)	W20	21	(21)
C12	690	(720)	L20	21	(21)
B10	680	(713)	T20	20	(20)
F10	524	(534)	B20	14	(14)
G12	361	(364)	ZZ10	14	(14)
K10	343	(354)	H20	11	(11)
V10	306	(309)	CC12	9	(9)
W10	302	(304)			
H10	302	(302)			
SH10	219	(219)			
C11	212	(213)			
CK10	187	(188)			
LL10	186	(186)			
CH10	172	(173)			
LE22	171	(171)			
TH11	159	(161)			
SS10	158	(158)			
G11	154	(155)			
NG10	146	(148)			
S20	122	(123)			
N20	108	(108)			
TT10	93	(93)			
GH10	86	(86)			
J10	80	(80)			
X10	74	(74)			
RR10	65	(65)			
S31	63	(63)			
QU10	62	(62)			
Z10	54	(55)			
FF10	51	(51)			
Y10	48	(49)			
DD10	44	(44)			
NN10	41	(41)			
PP10	41	(41)			
TCH10	40	(40)			
WH10	38	(38)			
PH10	31	(32)			
S21	31	(31)			
BB10	30	(30)			

(Table 2, continued)

73 Primary Vowel Rules						33 Secondary Vowel Rules		
E18	1136	(1146)	E38	17	(17)	EA11	214	(214)
I15	502	(502)	I25	17	(17)	EE10	176	(177)
E21	451	(452)	I26	17	(17)	AI10	143	(144)
Y17	421	(421)	I38	16	(16)	OU10	121	(121)
A17	405	(405)	O22	16	(16)	OO11	118	(118)
I16	397	(397)	A38	14	(14)	AY10	71	(71)
A16	376	(376)	Y11	14	(14)	OA10	70	(70)
E17	347	(347)	Y15	14	(14)	OW11	69	(69)
A15	331	(331)	A12	12	(12)	EA31	61	(61)
U16	313	(315)	U26	9	(9)	OW12	55	(56)
E15	300	(300)	E25	8	(8)	OO12	49	(49)
U15	282	(283)	U20	8	(8)	AW10	42	(42)
E16	272	(274)	I12	7	(7)	EW10	38	(38)
A11	250	(250)	I14	6	(6)	IE12	38	(38)
O17	212	(212)	O32	6	(6)	AU10	37	(37)
I11	209	(211)	O38	6	(6)	OI10	36	(36)
O16	173	(174)	A14	5	(5)	OU31	34	(34)
E13	168	(168)	O14	4	(4)	UE10	26	(26)
A21	163	(163)	U17	4	(4)	OU35	25	(25)
O21	160	(160)	A32	3	(3)	OU10	22	(22)
O11	146	(146)	E26	2	(2)	EY17	20	(20)
O15	113	(114)	O12	2	(2)	OU33	18	(18)
O13	91	(91)	O26	2	(2)	EI10	16	(16)
A13	77	(77)	U14	2	(2)	EA33	15	(15)
O24	72	(73)	I32	1	(1)	EI20	15	(15)
U11	66	(66)	U12	1	(1)	IE17	15	(15)
I13	63	(63)	U32	1	(1)	OU34	11	(11)
O31	62	(62)				UI10	10	(10)
U31	56	(56)	8,379		8,402	AI17	9	(9)
I17	45	(45)				IE11	9	(9)
I24	45	(45)				OE10	8	(8)
U13	41	(41)				EY10	7	(7)
I21	38	(38)				UI31	7	(7)
O23	38	(38)						
A23	37	(37)				1,605		1,608
E19	35	(35)						
O25	36	(36)						
Y19	31	(32)						
A25	30	(30)						
E11	30	(30)						
E32	30	(30)						
A24	29	(29)						
I22	26	(27)						
A22	23	(23)						
A29	19	(19)						
E14	18	(18)						

(Table 2, continued)

23 Consonant Rule 40s			6 Primary Vowel Rule 40s			16 Secondary Vowel Rule 40s		
	Word Freq.	Occur. Freq.		Word Freq.	Occur. Freq.		Word Freq.	Occur. Freq.
S40	62	(62)	A40	128	(128)	EA40	18	(18)
H40	18	(18)	O40	107	(107)	OO40	12	(12)
N40	18	(18)	E40	88	(88)	EI40	10	(10)
G40	15	(15)	I40	79	(79)	EY40	9	(9)
T40	15	(15)	U40	29	(30)	AU40	8	(8)
CH40	12	(12)	Y40	15	(16)	AI40	6	(6)
D40	12	(12)				IE40	6	(6)
TH40	12	(12)		446	(448)	UE40	6	(6)
GH40	11	(11)				OA40	5	(5)
QU40	11	(11)				OE40	5	(5)
L40	6	(6)				OI40	4	(4)
WH40	7	(7)				OU40	4	(4)
X40	7	(7)				EE40	2	(2)
P40	6	(6)				EW40	2	(2)
SS40	6	(6)				AY40	1	(1)
NG40	5	(5)				OY40	1	(1)
B40	44	(4)					99	(99)
C40	4	(4)						
W40	3	(3)						
R40	2	(2)						
F40	1	(1)						
Z40	1	(1)						
ZZ40	1	(1)						
	239	(239)						

TABLE 3a

This table is a breakdown of the rules into the following categories:

(1) Number of syllables (either one- or two-syllable words)

(2) Age level (either 6-7 or 8-9) for vocabulary words[14]

(3) Regularity (either not occurring with a Rule 40 ("Reg.") or occurring with a Rule 40 ("Exc.").

This breakdown included all of the correspondence rules except the 40 rules (exception rules), which are found in Table 3b. The total number of occurrences of each rule, obtained from the list of coded words in the Words by Rules[15] printout, was divided into the following eight categories:

(1) One syllable, 6-7 age level, regular words

(2) One syllable, 6-7 age level, exception words

(3) One syllable, 8-9 age level, regular words

(4) One syllable, 8-9 age level, exception words

(5) Two syllables, 6-7 age level, regular words

(6) Two syllables, 8-9 age level, exception words

(7) Two syllables, 8-9 age level, regular words

(8) Two syllables, 8-9 age level, exception words

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[14]See Berdiansky, Cronnell, and Koehler (1969), pp. 10, for discussion of age level assignments.

[15]See Berdiansky, et al, pp. 43-44.

TABLE 3a RANK-ORDERED RULE FREQUENCIES: BREAKDOWN BY AGE AND SYLLABIFICATION*

	ONE SYLLABLE				TWO SYLLABLES					
	6		8		6		8		Total Word	Occur.
	Reg.	Exc.	Reg.	Exc.	Reg.	Exc.	Reg.	Exc.	Freq.	Freq.
RULE										
R10	645	32	94	6	850	130	512	76	2345	(2512)
T10	528	28	54	3	584	77	351	45	1670	(1803)
N10	356	11	51	1	544	109	312	57	1441	(1528)
L10	430	25	91	4	445	83	269	44	1391	(1428)
S10	468	18	75	5	387	50	247	41	1294	(1322)
E18	461	35	86	7	234	60	201	52	1136	(1146)
D10	326	19	33	1	334	60	207	30	1010	(1060)
P10	340	13	40	1	314	59	166	22	955	(993)
M10	244	17	31	2	272	64	164	35	830	(852)
C12	174	9	30	2	231	43	178	23	690	(720)
B10	225	11	28	2	255	34	109	16	680	(713)
F10	176	8	27	2	176	20	104	11	524	(534)
I15	211	2	19	0	146	31	74	19	502	(502)
E21	17	0	2	1	294	23	106	8	451	(452)
Y17	0	0	0	0	290	28	95	8	421	(421)
A17	0	0	0	0	196	57	120	37	405	(405)
I16	23	0	8	0	218	16	121	8	394	(397)
A16	20	2	3	0	218	20	106	7	376	(376)
G12	134	6	27	2	103	25	56	8	361	(364)
E17	0	0	0	0	189	25	116	17	347	(347)
K10	170	4	19	0	108	4	36	2	343	(354)
A15	221	3	21	1	45	4	33	2	331	(331)
U16	20	0	5	0	172	13	97	6	313	(315)

*The 166 regular rules are rank-ordered by their word frequencies. In all cases but 6, this rank order is the same as it would be for the rules' occurrence frequencies. The occurrence frequencies are given in parentheses in the last column. Rules having the same word frequency are listed alphabetically. The 45 Rule 40s are ranked separately in Table 3b.

(Table 3a, continued)

	ONE SYLLABLE				TWO SYLLABLES					
	6		8		6		8		Total Word	Occur.
	Reg.	Exc.	Reg.	Exc.	Reg.	Exc.	Reg.	Exc.	Freq.	Freq.
RULE										
V10	63	4	21	3	110	12	77	16	306	(309)
H10	106	8	8	1	94	11	65	9	302	(302)
W10	124	9	14	0	91	16	45	4	302	(304)
E15	133	1	16	1	91	3	49	6	300	(300)
U15	176	0	27	0	44	8	24	4	282	(283)
E16	23	2	11	0	127	10	94	5	272	(274)
A11	133	0	15	0	61	1	36	4	250	(250)
SH10	85	4	19	0	56	15	34	6	219	(219)
EA11	101	0	10	2	61	4	34	2	214	(214)
C11	51	1	10	1	78	12	52	7	212	(213)
O17	0	0	0	0	100	24	71	17	212	(212)
I11	88	0	13	1	53	1	47	6	209	(211)
CK10	66	0	6	0	78	1	35	1	187	(188)
LL10	62	1	8	0	75	4	33	3	186	(186)
EE10	85	1	13	0	57	0	20	0	176	(177)
O16	6	0	2	1	99	3	55	7	173	(174)
CH10	83	2	16	0	39	9	18	5	172	(173)
LE22	0	0	0	0	117	3	51	0	171	(171)
E13	0	0	0	0	70	3	87	8	168	(168)
A21	51	0	5	0	67	6	32	2	163	(163)
O21	31	1	6	1	66	5	46	4	160	(160)
TH11	70	5	11	1	42	4	26	0	159	(161)
SS10	28	2	4	0	52	3	62	7	158	(158)
G11	35	0	14	0	44	15	30	16	154	(155)
O11	73	4	14	0	30	5	17	3	146	(146)
NG10	43	0	3	0	72	6	20	0	146	(148)
AI10	60	0	5	0	45	1	32	0	143	(144)
S20	26	2	5	0	39	12	31	7	122	(123)
OU10	44	2	10	0	36	2	25	2	121	(121)
OO11	57	1	9	0	28	5	16	2	118	(118)
O15	75	0	8	0	20	1	9	0	113	(114)
N20	41	0	5	0	36	5	20	1	108	(108)
TT10	2	0	0	0	68	2	21	0	93	(93)
O13	0	1	0	0	57	3	28	2	91	(91)
GH10	37	1	4	0	22	2	20	0	86	(86)
J10	26	0	1	0	28	3	17	5	80	(80)
A13	0	0	1	1	46	2	25	2	77	(77)
X10	15	0	5	0	25	2	27	0	74	(74)
O24	28	0	6	0	23	1	14	0	72	(73)
AY10	23	0	1	0	31	5	11	0	71	(71)

(Table 3a, continued)

	ONE SYLLABLE				TWO SYLLABLES					
	Reg.	Exc.	Reg.	Exc.	Reg.	Exc.	Reg.	Exc.	Total Word Freq.	Occur. Freq.
RULE										
OA10	36	0	9	0	15	0	9	1	70	(70)
OW11	26	0	2	0	34	3	4	0	69	(69)
U11	20	3	5	0	13	7	12	6	66	(66)
RR10	2	1	1	0	44	3	14	0	65	(65)
I13	3	0	0	0	47	3	13	0	63	(63)
S31	17	5	1	0	21	1	4	0	63	(63)
O31	17	2	1	0	28	3	11	0	62	(62)
QU10	25	0	8	0	16	1	11	1	62	(62)
EA31	24	1	2	0	28	1	5	0	61	(61)
U31	7	0	0	0	36	2	10	1	56	(56)
OW12	26	0	3	0	21	1	4	0	55	(56)
Z10	17	0	9	0	15	3	8	2	54	(55)
FF10	13	0	1	0	18	3	16	0	51	(51)
OO12	21	0	0	0	20	1	6	1	49	(49)
Y10	13	2	7	1	17	1	1	1	48	(49)
I17	0	0	0	0	19	4	14	8	45	(45)
I24	16	0	2	0	13	1	13	0	45	(45)
DD10	2	0	0	0	32	0	10	0	44	(44)
AW10	23	1	4	0	6	0	8	0	42	(42)
NN10	2	0	0	0	34	0	5	0	41	(41)
PP10	1	1	0	0	31	0	7	1	41	(41)
U13	0	0	0	0	25	3	11	2	41	(41)
TCH10	23	0	6	0	10	0	1	0	40	(40)
EW10	18	0	3	0	10	1	6	0	38	(38)
I21	21	0	1	0	10	1	5	0	38	(38)
IE12	11	0	6	0	11	1	8	1	38	(38)
O23	22	0	2	0	7	0	7	0	38	(38)
WH10	17	2	2	0	11	1	5	0	38	(38)
A23	19	1	2	0	10	1	4	0	37	(37)
AU10	11	0	3	0	13	0	10	0	37	(37)
O25	5	0	2	0	20	3	6	0	36	(36)
OI10	15	0	3	0	9	1	6	2	36	(36)
E19	12	5	4	0	7	2	4	1	35	(35)
OU31	5	0	0	0	18	0	11	0	34	(34)
PH10	3	3	0	0	6	4	7	8	31	(32)
S21	15	0	1	0	5	2	8	0	31	(31)
Y19	15	1	0	0	10	0	5	0	31	(32)
A25	10	0	1	0	9	2	7	1	30	(30)
BB10	2	0	0	0	23	0	5	0	30	(30)
E11	5	0	2	0	5	2	16	0	30	(30)

(Table 3a, continued)

	ONE SYLLABLE				TWO SYLLABLES					
	6		8		6		8		Total Word	Occur.
	Reg.	Exc.	Reg.	Exc.	Reg.	Exc.	Reg.	Exc.	Freq.	Freq.
RULE										
E32	1	0	0	0	15	4	3	7	30	(30)
A24	13	0	1	0	11	0	3	1	29	(29)
GG10	1	0	0	0	19	0	7	0	27	(27)
I22	13	0	0	0	9	0	5	0	27	(27)
CH31	3	3	1	0	5	8	3	3	26	(26)
K20	14	0	2	0	8	1	1	0	26	(26)
UE10	11	0	2	0	4	5	3	1	26	(26)
OU35	11	0	1	0	8	2	3	0	25	(25)
TH12	1	1	0	2	17	2	2	0	25	(25)
MM10	0	0	0	0	17	1	6	0	24	(24)
A22	1	0	0	0	18	2	2	0	23	(23)
G31	7	1	1	0	9	1	2	1	22	(22)
OY10	3	0	1	0	12	0	6	0	22	(22)
TH13	14	4	1	0	1	2	0	0	22	(22)
L20	10	2	1	1	5	1	1	0	21	(21)
W20	10	0	1	0	5	1	4	0	21	(21)
EY17	0	0	0	0	15	1	4	0	20	(20)
T20	0	0	0	0	12	0	7	1	20	(20)
A29	9	0	0	0	8	0	2	0	19	(19)
E14	0	0	0	0	9	0	8	1	18	(18)
OU33	10	1	1	0	3	0	3	0	18	(18)
E38	0	0	0	0	12	0	5	0	17	(17)
I25	1	0	0	0	10	0	6	0	17	(17)
I26	0	0	0	0	13	0	4	0	17	(17)
EI10	1	0	2	0	7	1	4	1	16	(16)
I38	2	0	0	0	8	0	6	0	16	(16)
O22	7	0	0	0	4	1	4	0	16	(16)
EA33	6	0	2	0	4	0	2	1	15	(15)
EI20	9	0	0	1	4	0	1	0	15	(15)
IE17	0	0	0	0	11	2	2	0	15	(15)
A38	1	0	0	0	6	1	6	0	14	(14)
B20	8	3	0	0	2	0	1	0	14	(14)
Y11	2	1	1	0	3	0	7	0	14	(14)
Y15	1	1	3	0	4	1	4	0	14	(14)
ZZ10	2	0	1	0	7	0	4	0	14	(14)
A12	0	0	0	0	9	0	3	0	12	(12)
H20	3	4	0	3	1	0	0	0	11	(11)
OU34	8	0	0	0	1	0	2	0	11	(11)
UI10	3	0	1	0	4	0	2	0	10	(10)
AI17	8	0	1	0	0	0	0	0	9	(9)

(Table 3a, continued)

	ONE SYLLABLE				TWO SYLLABLES					
	6		8		6		8		Total Word	Occur.
	Reg.	Exc.	Reg.	Exc.	Reg.	Exc.	Reg.	Exc.	Freq.	Freq.
RULE										
CC12	0	0	0	0	5	0	4	0	9	(9)
IE11	5	0	0	0	2	0	2	0	9	(9)
U26	0	0	0	0	8	0	0	1	9	(9)
E25	6	0	0	0	2	0	0	0	8	(8)
OE10	5	0	0	0	1	0	2	0	8	(8)
U20	5	0	0	0	0	2	1	0	8	(8)
EY10	4	0	1	0	1	0	1	0	7	(7)
I12	5	0	1	1	0	0	0	0	7	(7)
UI31	2	0	0	0	2	0	3	0	7	(7)
I14	0	0	0	0	2	0	4	0	6	(6)
O32	0	0	0	0	3	1	1	1	6	(6)
O38	0	0	0	0	1	0	4	1	6	(6)
A14	0	0	0	0	3	0	2	0	5	(5)
O14	0	0	0	0	3	0	1	0	4	(4)
U17	0	0	0	0	3	1	0	0	4	(4)
A32	0	0	0	0	2	1	0	0	3	(3)
E26	0	0	0	0	1	0	1	0	2	(2)
O12	0	0	0	0	1	0	0	1	2	(2)
O26	0	0	0	0	2	0	0	0	2	(2)
U14	0	0	0	0	0	0	1	1	2	(2)
I32	0	0	0	0	1	0	0	0	1	(1)
U12	0	0	0	0	1	0	0	0	1	(1)
U32	0	0	0	0	0	1	0	0	1	(1)

TABLE 3b RANK-ORDERED RULE 40 FREQUENCIES: BREAKDOWN BY AGE AND SYLLABIFICATION

	ONE SYLLABLE		TWO SYLLABLES			
	6	8	6	8	Total Word Freq.	Occur. Freq.
RULE						
A40	23	3	76	26	128	(128)
O40	27	1	54	25	107	(107)
E40	8	3	42	35	88	(88)
I40	11	0	47	21	79	(79)
S40	12	3	34	13	62	(62)
U40	5	1	18	5	29	(30)
EA40	5	2	7	4	18	(18)
H40	3	1	8	6	18	(18)
N40	2	0	7	9	18	(18)
G40	3	2	4	6	15	(15)
T40	0	0	11	4	15	(15)
Y40	5	1	4	5	12	(12)
CH40	2	1	6	3	12	(12)
D40	3	0	5	4	12	(12)
0040	4	0	7	1	12	(12)
TH40	2	0	5	5	12	(12)
GH40	6	1	3	1	11	(11)
QU40	1	2	6	2	11	(11)
EI40	5	1	2	2	10	(10)
EY40	2	0	5	2	9	(9)
AU40	2	1	4	1	8	(8)
L40	3	0	2	11	6	(6)
WH40	4	0	2	1	7	(7)
X40	0	0	3	0	7	(7)
AI40	3	0	3	0	6	(6)
IE40	1	1	4	0	6	(6)
P40	2	2	0	2	6	(6)
SS40	0	0	3	3	6	(6)
UE40	1	3	2	0	6	(6)
NG40	3	0	1	1	5	(5)
OA40	1	0	2	2	5	(5)
OE40	3	0	1	1	5	(5)
B40	2	0	0	2	4	(4)
C40	0	0	2	2	4	(4)
OI40	1	0	3	0	4	(4)
OU40	3	0	0	1	4	(4)
W40	2	0	1	0	3	(3)
EE40	1	0	1	0	2	(2)
EW40	1	0	1	0	2	(2)
R40	0	0	1	1	2	(2)

(Table 3b, continued)

	ONE SYLLABLE		TWO SYLLABLES			
	6	8	6	8	Total Word Freq.	Occur. Freq.
RULE						
AY40	1	0	0	0	1	(1)
F40	1	0	0	0	1	(1)
OY40	0	0	0	1	1	(1)
Z40	1	0	0	0	1	(1)
ZZ40	0	0	0	1	1	(1)

Data Processing for Table 4[17]

The data presented in Table 4 contain the following information from left to right: (a) the conditional frequency of rule pairs converted to percentage values; (b) co-occurring rules; (c) raw frequency of co-occurrence.

The procedure used to obtain this information consisted of the following steps:

(1) A computer generated matrix listed the frequency with which each rule occurred with each other rule and with itself (counting only one co-occurrence per word).

(2) The following deletions were made:

    (a) Individual rules with less than 20 exemplars
    (b) Rule 40s (exceptions).

(3) A second matrix, in which the marginal rules were rank ordered by occurrency frequency, was constructed from the data presented in the first matrix.

(4) The conditional frequency of rule pairs was obtained by dividing the number of co-occurrences for each rule pair by the number of words in which first rule of the pair occurred:

$$\frac{\text{number of co-occurrence of Rule 1 and Rule 2}}{\text{number of words containing Rule 1}}$$

These numbers were multiplied by 100 to make a percentage.

Only rule pairs with conditional frequencies of 40% or more are included in this table.

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[17]Due to revisions in programming policies there are possible small scale inaccuracies in the data of this table. The figures may differ by one or two percentage points; however, in most cases, the rank order of rule pairs is unaffected. In one case, Rule A25, co-occurrence frequencies are inaccurate because words were coded with Rule A25 after the first three steps described above were completed. However, frequency errors did not essentially affect the percentage values found for A25 in step 4.

Table 4: Rule pair-per-word frequencies and conditional frequencies

Conditional Frequency	Rule Pair	Frequency
100-91%	E21-R10	450
	A11-E18	246
	I11-E18	208
	A21-R10	161
	O21-R10	152
	O11-E18	145
	U11-E18	66
	I24-GH10	43
	I21-R10	35
	S21-E18	30
	E11-E18	29
	K20-N10	26
	W20-R10	21
90-81%	I24-T10	36
	E32-R10	27
	I22-D10	24
	A24-W10	24
	TH12-R10	22
	T20-S10	17
	A25-R10	10
80-71%	G11-E18	109
	GH10-T10	64
	I22-N10	21
	TH12-E21	20
70-61%	C11-S10	139
	E13-R10	103
	NG10-I15	100
	S10-E18	76
	N20-K10	68
	U31-F10	68
	U31-L10	36
	I17-E18	28
	O23-L10	25
	CH13-R10	16
	A22-RR10	15
	OU35-R10	15

Conditional Frequency	Rule Pair	Frequency
60-51%	O17-N10	107
	AI10-R10	74
	GH10-I24	43
	O23-D10	22
	PP10-R10	22
	E19-D10	20
	E11-R10	18
	OU31-R10	18
	CH31-S10	13
	G31-R10	12
	T20-LE22	11
	A25-W10	7
50-46%	F10-R10	241
	E17-N10	165
	E15-T10	147
	TH11-R10	72
	TT10-R10	46
	I13-R10	31
	EA31-R10	30
	S31-R10	29
	Z10-E18	26
	I21-T10	19
	IE12-R10	18
	A23-T10	18
	EW10-R10	18
	A23-LL10	17
	UE10-L10	13
	L20-K10	11

Conditional Frequency	Rule Pair	Frequency
45-41%	S10-T10	564
	C12-R10	292
	A17-R10	176
	G12-R10	159
	E17-T10	158
	U16-R10	137
	V10-E18	135
	V10-R10	124
	O17-R10	96
	C11-N10	91
	C11-R10	88
	O11-R10	65
	S20-R10	51
	OA10-R10	31
	X10-E16	31
	U11-R10	27
	Z10-R10	23
	U13-R10	18
	I24-L10	18
	I17-L10	18
	IE12-F10	16
	OI10-N10	15
	OI10-L10	15
	AU10-T10	15
	BB10-R10	13
	PH10-R10	13
	A24-S10	12
	T20-N10	8
	A25-QU10	5

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